FLIGHT

The AIRCRAFT ENGINEER & AIRSHIPS

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Founder and Editor : STANLEY SPOONER

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DIARY OF CURRENT AND FORTHCOMING EVENTS

Club Secretaries and others desirous of announcing the dates of important fixtures are invited to send particulars for inclusion in this list—

1928

Nov. 29.... Lecture, "Production Problems," by F. Sigrist, before R.Ae.S.
Dec. 3–8.... International Aeronautical Exhibition, Chicago, Ill.
Dec. 6.... Lecture, "Control of Aeroplanes by Alulas," by Capt. A. P. Thurston, before R.Ae.S.
Dec. 12–14 International Conference on Aviation, Washington, U.S.A.
Dec. 17.... R.Ae.S. Dinner to Mr. Orville Wright, at the South Kensington Science Museum

1929

May 21.... Northampton Air Pageant
July 13.... R.A.F. Display at Hendon
July 16–27 7th International Aero Exhibition, Olympia
Oct. 31.... Guggenheim Safe-Aircraft Competition Closes

EDITORIAL COMMENT

ON p. 1017 of this week's issue of FLIGHT will be found a full-page block which should be of more than usual interest to all who believe in the future of commercial aviation. It shows the network of air lines which are now either in actual operation or about to start in the very near future. Accurate figures are hard to come by, mainly owing to the rapidity with which the expansion of American air routes is taking place, but in round figures it may be said that the total length of the air routes now being operated daily in the United States of America is in the neighbourhood of 18,000 miles, while the daily number of miles flown must be well over 35,000. These are figures which do not tend to show up the statistics of British air lines in the most favourable light. Granted that our European routes are short, and that we have to all intents and purposes no internal air routes, our logical reply to the American expansion, and to the somewhat smaller but no less significant expansion of air routes in Europe operated by nations other than British, must be British Empire air routes. We do not belittle the difficulties that have had, and still have, to be overcome, but it cannot be said in all fairness that British progress has been other than lamentably slow. Empire aviation is so obviously our only salvation (in more than one sense) that to play with its development as we have been doing is not only regrettable but positively dangerous. If the British Empire is to endure, there is no more vital necessity to its future than improved communications. And these can only be achieved by making the fullest possible use of air transport.

18,000 Miles of Air Route

It is no manner of use trying to shelter under the difficulties with which we are faced. They *must* be overcome, and that very soon. Otherwise we shall live to regret the short-sightedness which permitted foreign nations to step in and provide the air communications which we ourselves were too lethargic to establish and maintain.

Even a small nation like Holland has shown what can be accomplished by determination. The flights

recently carried out by machines destined to be used in the Dutch East Indies services have proved beyond a doubt that, although this is not yet contemplated as an immediate step, it is possible to effect a most important speeding-up by a long-distance air mail route. While we have been "negotiating," Holland has got going. True, she has not, presumably, arranged with the various European governments for a *regular* passage of her air mail machines to the East, but her experimental machines have been permitted to take what we may term the "overland" route, which is a good deal shorter than the Mediterranean, or Southern route, which we are but now surveying.

The United States of America are very favourably situated for the purpose of *internal* air line operation, what with the great distances that have to be covered and comparatively few railways, and consequently there has been rapid progress once the ball had been started rolling. The British Empire has probably as much to gain by regular air communications as have the United States, but we have certainly not made anything like such a determined effort to "get going."

The American network began very modestly with a New York-Chicago line operated by Government machines. Then followed an extension in the form of an experimental night service, also operated by Government-owned and manned aircraft. The experiment proved that, given proper ground organisation and equipment, such as aerodromes, landing fields, searchlights, &c., a night air service could be operated with good regularity. Finally, the last stage of the New York-San Francisco route was flown regularly by Government equipment, and when that also had proved its worth, the American Government called for tenders and let out contracts to private companies, not only for the "feeder lines," but also for the main trans-continental route.

In this country we have done practically nothing in the way of extended experimentation with night flying. There have been spasmodic attempts, certainly, but we have never operated night services month in and month out. Yet night flying is bound to play an extremely important part in the operation of regular long-distance Empire air services. In something like five or six years, the United States have built up a network of air lines totalling more than 18,000 miles of route. In a greater number of years we have not got beyond the London-Paris and Cairo-Basra sections of our line to Australia. It is hoped to make a beginning next year with the London-Cairo "link," but the Karachi-Australia section still appears to be as far away as ever. Doubtless during next year Holland will begin her Amsterdam-Batavia services, and it seems likely that Australia will have to make use of them until such time as we manage to bestir ourselves. If Australians once begin to send their letters to England with a Dutch service as far as Karachi, for instance, they might as well let them go the whole way by Dutch machines. In that case our London-Karachi air service would lose a great deal of its potential value.

Any way one looks at the matter, it cannot be claimed that British Empire aviation is being tackled as seriously as it should be, and if the American example which we give this week should help towards a fuller realisation of this fact, we shall owe the United States something for the lead which she has given the British Empire.

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"The Motor Cycle of the Air"

The subject of the cheap single-seater, which was revived by FLIGHT some months ago, continues to exercise its appeal, and we receive letters daily relating to it and asking when such a machine is to be put on the market. Enquiries of this nature reach us from all quarters, and as far afield as Australia, whence one firm writes to tell us that they are willing to purchase either the manufacturing rights or to pay a substantial sum for the drawings of such a machine.

Before the "Motor Cycle of the Air" can materialise, however, it is necessary to make sure that the right engine is available for it, and it is little use putting the machine into production unless the engine that is to be fitted is ready at the same time. The A.B.C. "Scorpion" appears to fit the bill, and could, we believe, be put into production at any moment. The same applies to the Bristol "Cherub," the manufacture of which has ceased for the time being, but which could, and doubtless would, be produced again should the demand arise.

What seems to be necessary is that those prepared to produce the machine should at once get into touch with those willing to produce the engine in order that the necessary co-operation might be attained. That there would be a considerable market for a cheap single-seater we have not the slightest doubt. But it must be a good machine and fitted with a good engine.

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International Air Congress

LORD THOMSON, ex-Minister for Air, will represent Great Britain at the International Air Congress to be held at Washington, December 12, 14.

R.A.F. Sqadrons for India

Two bombing R.A.F. Squadrons, No. 11 (Netheravon) and No. 39 (Bircham Newton) are to leave for India at the end of December in the transport *Nevasa*. They will be additional units for India.

Filling the Breach

BRIG.-GEN. P. R. C. GROVES recently flew to Oxford from Stag Lane Aerodrome to keep a lecture appointment punctually after a taxi smash and a lost train had threatened to cause a delay. In spite of a two miles' walk into Oxford after landing, he was in time. He emphasised the need of an aerodrome at Oxford.

Rotterdam Air Meeting—1929

THE Rotterdam Aero Club has decided to hold a second international civil air meeting late in June, 1929, subject to mutual arrangements with the Dutch authorities and the Fédération Aéronautique.

Ex-Air Minister's African Survey

WITHIN the next fortnight Capt. F. E. Guest, M.P., will probably leave England in his Junker's monoplane for his air survey of the first half of the Cape to Cairo air route.

French Aviation

A WIDE development of French civil aviation is projected. M. Laurent Eynac, the Air Minister, proposes to substitute a policy of long contracts for the present spasmodic methods and to appeal to the French public for the organisation of new air lines and ports.

Canadian Air Programme

NEXT year the Canadian Government will spend £80,000 to secure 70 aircraft for the Royal Canadian Air Force and promote civil aviation. A large part will be spent on the light aeroplane class and there will also be transport and photographic machines. Orders will be placed with Canadian and British manufacturers as far as possible.

PUZZLE, FIND THE AIRSHIP: An aerial view of New York City, with the Goodyear "Puritan" airship cruising among the skyscrapers. The "Puritan" (which was described in our issue for Oct. 25, last) is 128 ft. long.

AMERICAN AIR LINES

AMERICAN passenger, express and mail air services have grown to such an extent during 1928 that we think the following particulars of the various services now in operation, or projected, will be of interest to our readers. The following is a list of all the principal services carrying mail (*M.*), passengers (*P.*), and express (*E.*), now in operation—or commencing very shortly—as far as we have been able to ascertain. In addition to this list we also give a map showing these routes, from which it will be seen that the United States are fairly well covered. We also include the lines operating in the West Indies and Central American area.

In every case, mails are carried under contract from the U.S. Government, while some of the operating companies carry passengers and/or express freight in addition; some carry passengers or express only. Originally, it will be remembered, mails were transported only between New York and San Francisco by U.S. Post Office machines. Subsequently a few "feeder" lines were added, under contract, and finally the Transcontinental route itself was operated under contract.

New York-Chicago (723 miles), via Cleveland and Toledo. *M.P.E. Operated by* National Air Transport, Inc. (N.A.T.). *Equipment*—20 Douglas ("Liberty 12"); 8 Travel Air (Wright J-5); 7 Curtiss "Pigeon" ("Liberty 12"); 1 Pitcairn "Mailwing" (Wright J-5); 1 Arial Mercury ("Liberty 12").

Toledo-Detroit (50 miles). Branch line by N.A.T.

Chicago-Dallas (995 miles), *via* Moline St. Joseph: Kansas City: Wichita: Ponca City: Oklahoma City: Fort Worth. *M.P.E.* National Air Transport, Inc. (N.A.T.).

Ponca City-Tulsa (72 miles). Branch line by N.A.T., and also passenger service operated by Bluebird Airway.

Tulsa-Oklahoma City (100 miles) and Tulsa-Ponca City (72 miles). *P. Operated by* Paul R. Bramiff, Inc. *Equipment*—Stinson Detroiter Sm-IB (Wright J-5).

Chicago-San Francisco (1,949 miles), *via* Iowa City: Des Moines: Omaha: North Platte: Cheyenne: Rock Springs: Salt Lake: Elko: Reno; Sacramento and Oakland. *M.P.E. Operated by* Boeing Air Transport, Inc. *Equipment*—8 Boeing 40-A ("Wasp"); 14 Boeing 40-B ("Hornet") 1 Boeing 80 ("Wasp").

New York-Boston (219 miles), *via* Hartford. *M.P.E. Operated by* Colonial Air Transport, Inc. *Equipment*—7 Fairchild monoplanes (Wright J-5) and 3 Pitcairn "Mailwings" (Wright J-5).

New York-Atlanta (763 miles), *via* New Brunswick: Philadelphia: Washington: Richmond: Greenboro: Spartanburg. *M. Operated by* Pitcairn Aviation, Inc. *Equipment*—15 Pitcairn "Orowings" (Ox-5); 8 Pitcairn "Mailwings" (Wright J-5); 6 Pitcairn "Fleetwings" (Ox5 & K-6); 1 Fairchild Cabin (Wright J-5).

Atlanta-Miami (612 miles), *via* Macon, Jacksonville. Extension of above. *M.*

New York-Washington (181 miles). *P.E. Operated by* U.S. Air Transport Inc. *Equipment*—Ryan Brougham (Wright J-5).

New York-Montreal (350 miles), *via* Albany. *M.P. Operated by* Canadian Colonial Airways, Inc. *Equipment*—4 Fairchild "all purpose" ("Wasp"); 2 Pitcairn "Mailwings" (Wright J-5).

Albany-Cleveland (445 miles), *via* Schenectady: Utica: Syracuse: Rochester: Buffalo. *M.P.E. Operated by* Colonial Western Airways, Inc. *Equipment*—4 Fairchild Cabins (Wright J-5); 2 Pitcairn "Mailwings" (Wright J-5).

Cleveland-Pittsburgh (121 miles), *via* Youngstown. *M.P. Operated by* Clifford Bell.

Cleveland-Detroit (155 miles). *M.P. Operated by* Ford Motor Co. (and Stout Air Services, Inc.). *Equipment*—Ford-Stout tri-motor (Wright J-5).

Detroit-Chicago (252 miles). *M.* Ford Motor Co.

Detroit-Buffalo (218 miles). *E.* Ford Motor Co.

Cleveland-Louisville (350 miles), *via* Akron: Columbus: Dayton: Cincinnati. *M.P. Operated by* Continental Air Lines, Inc. *Equipment*—4 Travel Air (Wright J-5).

Cleveland-Chicago (318 miles). *P.E. Operated by* Universal Air Lines. *Equipment*—3 Hamilton metal 'planes; 1 Fairchild Cabin mono.

Chicago-Minneapolis-St. Paul (399 miles), *via* Milwaukee; Madison: La Crosse. *M.P.E. Operated by* Northwest Airways, Inc. *Equipment*—3 Stinson Detroiter (Wright J-5); 3 Waco 10 (Ox-5); 2 Hamilton metal 'planes (P. & W. "Hornet"); 1 Laird Commercial (Wright J-5). Passenger and express service also operated by Universal Air Lines.

Minneapolis-Fargo (230 miles), *via* St. Paul: Alexandria. *P.E. Operated by* Universal Air Lines.

Minneapolis-Duluth (130 miles). *P.E. Operated by* Universal Air Lines.

Detroit-Chicago (265 miles), *via* Ann Arbor: Jackson: Battle Creek: Kalamazoo: South Bend: La Poste. *M. Operated by* Thompson Aeronautical Corp. *Equipment*—4 Stinson mono (Wright J-5), 1 Laird (Wright J-5).

Kalamazoo-Bay City (130 miles), *via* Lansing: Saginaw: *M.* Branch of above.

Kalamazoo-Muskegon (85 miles), *via* Grand Rapids. *M.* Branch of above.

Chicago-Cincinnati (267 miles). *via* Indianapolis. *M.P.E. Operated by* Embry Riddle Co. *Equipment*—8 Waco 10 (Ox-5 and Wright J-5); 4 Fairchild Cabin (Wright J-5); 2 Ryan Brougham (Wright J-5); 1 Stinson cabin (Wright J-5).

Chicago-Atlanta (623 miles), *via* Terre Haute: Evansville: Nashville: Chattanooga. *M. Operated by* Interstate Air Lines, Inc.

Evansville-St. Louis (145 miles). *M.* Branch of above.

Atlanta-Chattanooga (107 miles). *P.E. Operated by* Tennessee Air Transport Co. *Equipment*—2 Travel Air (Hispano E).

Chicago-Memphis (480 miles). *P. Operated by* Mid-South Airways, Inc. *Equipment*—3 Stinson Detroiter (Wright J-5).

Chicago-St. Louis (268 miles), *via* Peoria: Springfield. *M.P.E. Operated by* Robertson Aircraft Corp. *Equipment*—4 Ford trimotor (Wright J-5); 3 Ryan Brougham (Wright J-5); 2 Travel Air (J-5); also 30 D.H., Standard, Travel Air and Waco.

St. Louis-Omaha (401 miles), *via* Kansas City. *M.* Branch of above.

Atlanta-New Orleans (483 miles), *via* Birmingham: Mobile. *M.P. Operated by* St. Tammany Gulf Coast Airways, Inc. *Equipment*—1 Fokker Universal; 1 Pitcairn "Mailwing"; 1 Travel Air (all Wright J-5).

New Orleans-Laredo (615 miles), *via* Houston. *M.* Branch of above; also branches to Brownsville.

New Orleans-Pilottown (75 miles). *M. Operated by* New Orleans Air Line.

Galveston-Dallas (308 miles), *via* Houston: Waco: Fort Worth. *M.P. Operated by* Texas Air Transport, Inc. *Equipment*—4 Pitcairn "Mailwings"; 3 Swallow; 1 Ryan B-1.

Dallas-San Antonio (281 miles), *via* Fort Worth: Waco: Austin. *M.P.* Branch of above.

Cheyenne-Pueblo (200 miles), *via* Denver: Colorado Springs. *M.P.E. Operated by* Western Air Express. *Equipment*—Douglas, Fokker and Stearman.

Salt Lake City-Los Angeles (633 miles), *via* Las Vegas. *M.P.E.* Branch of above.

Salt Lake City-Great Falls (489 miles), *via* Ogden: Pocatello: Butte: Helena. *M.P.E. Operated by* National Parks Airways, Inc. *Equipment*—4 Fokker Super-Universal (P. & W. "Wasp").

Salt Lake City-Pasco (540 miles), *via* Boise. *M. Operated by* Varney Air Lines. *Equipment*—7 Stearman; 4 Swallow.

Seattle-Los Angeles (1,080 miles), *via* Tacoma: Portland: Midford: Oakland S.F.: Fresno: Bakersfield. *M.P.E. Operated by* Pacific Air Transport, Inc. *Equipment*—Boeing 40-C (P. & W. "Wasp"). Also Passenger and Express Service operated between Seattle-Tacoma-Chehalis-Portland-Medford-Corning and San Francisco by West Coast Air Transport Co. with Bach mono. (Wasp-Siemens).

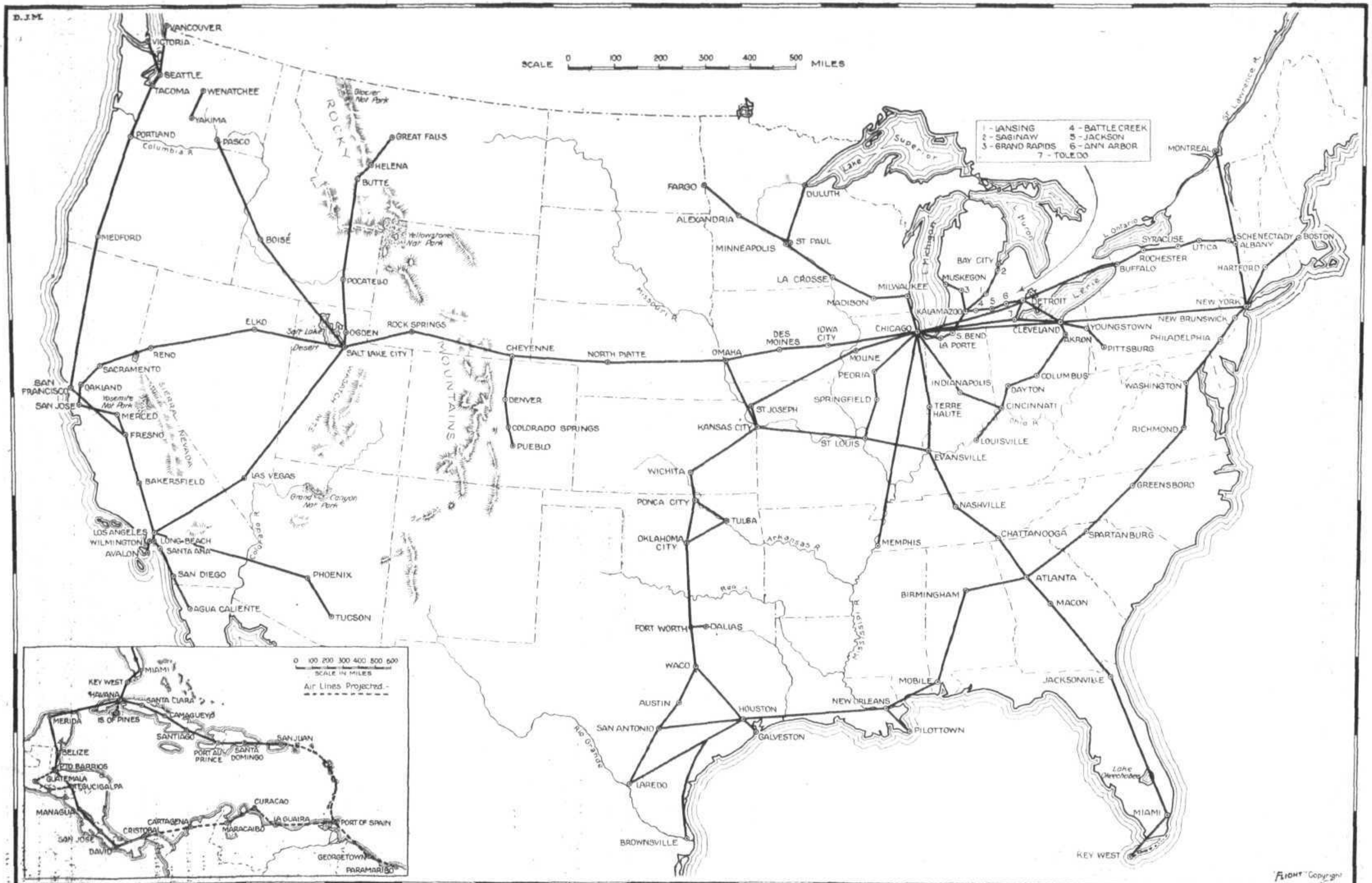
Seattle-Victoria (77 miles). *M.P. Operated by* North-West Airways.

Seattle-Vancouver (125 miles). *P.E. Operated by* Commercial Air Transport, Inc. *Equipment*—Ryan Brougham (Wright J-5).

San Francisco (Oakland)-Agua Caliente (570 miles), *via* Fresno: Bakersfield: Los Angeles: Long Beach: Santa Ava: San Diego. *P.E. Operated by* Maddux Air Lines, Inc. *Equipment*—5 Ford Tri-motor (Wright J-5); 1 Lockheed (Wright J-5).

Los Angeles-Oakland (410 miles), *via* Fresno: Merced: San Jose. *P.E. Operated by* Mutual Aircraft Corp. *Equipment*—6 Ryan Brougham (Wright J-5).

Los Angeles-Tucson (440 miles), *via* Phœnix. *P.E. Operated by* Standard Air Lines, Inc. *Equipment*—Fokker Universal (Wright J-5).



MAIL, PASSENGER AND EXPRESS AIR SERVICES IN THE UNITED STATES: This map shows the "network" of Airways now operating in the States; connections are (and others will be) made with air lines in Canada, Cuba, Haiti, Dominican Rep., and South America.

Yakima-Wenatchee (65 miles). *P.E.* *Operated by* Western Airlines, Inc.

Wilmington-Avalon (32 miles). *P.E.* *Operated by* Pacific Marine Airways.

Key West-Havana (104 miles). *M.P.* *Operated by* Pan-American Airways, Inc. *Equipment*—Fokker F-10 tri-motor (P. & W. "Wasp").

Key West-Miami (130 miles). *M.P.* Branch of above.

Havana-Cristobal (Panama) (1,700 miles), *via* Merida: Belize: Pts. Barrios: Tegucigalpa: Managua: San Jose: David. *M.P.* Branch of above. (Extension to Paramaribo, Dutch Guiana, projected.)

Havana-San Juan (Porto Rico) (1,130 miles), *via* Santa Clara: Camaguey: Santiago: Port-au-Prince: Santo Domingo. *M.P.* Branch of above. (Extension to Port of Spain and Paramaribo *via* Leeward Islands projected.)

Note.—Other companies are, or were, operating "local" passenger and express services over certain sections of the routes included above.

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The Royal Aero Club of the United Kingdom

OFFICIAL NOTICES TO MEMBERS

World's Records.—The Royal Aero Club has been notified by the Federation Aeronautique Internationale that the following World's Records have been granted:—

CLASS C.—(*Aeroplanes.*) *Useful load transported.* 500 kilos.

Height: (Germany—Reginald Schinzinger, Dessau, September 14, 1928, Junkers W.34 Monoplane, 420 h.p. Bristol Jupiter VII, 9,190 m.

1,000 *kilos.*

Height: (Germany)—Reginald Schinzinger, Dessau, September 14, 1928, Junkers W.34 Monoplane, 420 h.p. Bristol Jupiter VII, 7,907 m.

Light Aeroplanes—First Category.—(Two-seaters weighing not more than 400 kilos.)

Distance in a straight line: (Switzerland).—Capt. Hans Wirth and Miss Erika Naumann, Boblingen-Mieschkance (Poland), October 16, 1928, Klemm-Daimler Monoplane, 20 h.p. Mercedes-Daimler, 1,305·500 kms.

CLASS CA (*Seaplanes*). *Useful Load transported.* 500 *kilos.*

Height: (Germany)—Fritz Harder, Dessau, November 6, 1928, Junkers W.34 Monoplane, 420 h.p. Bristol Jupiter VII, 7,458 m.

1,000 *kilos.*

Height: (Germany)—Franz Kneer, Dessau, November 7, 1928, Junkers W. 34 Monoplane, 420 h.p. Bristol Jupiter VII, 6,389 m.

Twenty-Fifth Anniversary of the Wright Brothers' First Flight.—Lord Thomson, Chairman of the Royal Aero Club is attending the International Air Congress at Washington on December 12, 14, and will hand to Mr. Orville Wright, a letter conveying the warmest greetings from the Royal Aero Club on the twenty-fifth anniversary of the first flight made by the Wright Brothers.

British Speed Record.—The figures given in last week's Official Notices were incorrect.

The speed accomplished by Flt.-Lieut. D. D'Arcy A. Greig on November 4, over the 3-km. course, was 319·57 m.p.h. = 514·308 km. per hour.

ASSOCIATED LIGHT AEROPLANE CLUBS' GENERAL COUNCIL

Deputation to the Secretary of State for Air.—Representatives of Associated Light Aeroplane Clubs were received at the House of Commons on Friday, November 23, by the Right Hon. Sir Samuel J. G. Hoare, Secretary of State for Air, when an informal conference took place as to the future of the Light Aeroplane Clubs. The deputation was introduced by Lt.-Col. J. T. C. Moore-Brabazon, M.P.

The following clubs were represented:—Royal Aero Club (Lt.-Col. M. O'Gorman, C.B., H. E. Perrin). Bristol and Wessex A.C. (A. H. Downes-Shaw). Hampshire A.C. (H. J. Harrington). Lancashire A.C. (Major Alan R. Goodfellow). London A. C. (Major K. M. Beaumont, D.S.O., Major R. H. Mayo, O.B.E.). Midland A.C. (Major G. Dennison). Norfolk and Norwich A.C. (G. F. Surtees). Nottingham A.C. (C. R. Sands). Royal Aircraft Establishment A.C. (P. N. G. Peters). Yorkshire A.C. (F. G. Wayman).

Mr. John Lord and Mr. C. C. Walker attended on behalf of the Society of British Aircraft Constructors.

Offices: THE ROYAL AERO CLUB,
3, CLIFFORD STREET, LONDON, W.1.
H. E. PERRIN, Secretary.

DEATH OF MR. HEDGES BUTLER

WE regret to announce the death of Mr. Frank Hedges Butler, to whom the credit was due for the idea which originated the Royal Aero Club. He died on November 27, in a London nursing home, at the age of 72 years. His very active life was closely associated with the pioneering in motor transport and aircraft, and he travelled extensively in all parts of the world. In business he was an expert wine merchant. Many interesting travel books came from his pen, the first being "Five Thousand Miles in a Balloon" published in 1907. Others were, "Across Lapland with Reindeer and Skis" and "Fifty Years of Travel by Land, Water and Air."

When he resumed travelling after the war it resulted in a further book entitled, "Round the World." Motoring became his pursuit in the earliest days and he was a member of the Automobile Club of France before becoming the first hon. treasurer of the Royal Automobile Club.

Ballooning was undoubtedly his greater passion, for he made over one hundred ascents which included many records. In 1905 he made the longest cross-Channel voyage by starting from London and landing at Caen, Normandy. It was stated that during an ascent in 1901, when the Hon. C. S. Rolls was one of his passengers, the idea of forming an Aero Club occurred to him. On November 15, 1901, the inaugural balloon ascent of the club was made from Chelsea, and when an altitude of several hundred feet had been gained Miss Vera Butler unfurled a white banner on which were the words "Aero Club."

Mr. Butler's accomplishments, however, were not narrowed. In 1874 he was first violin at the Handel Festival, and he was an active member of many choral societies, as well as founder of the Lyric Club Orchestra and the Imperial Institute Orchestral Society. Big game shooting, yachting and golf were other hobbies. He was a life Fellow of the Royal Geographical Society. His only daughter, Vera, married Col. H. I. Nicholl, D.S.O.

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China

LUFTHANSA, the German civil aviation combine, is reported to be interested in an air service to the Far East. A representative has been in China for some time and whatever negotiations have been carried on it is thought they would concern an air service in China.

New Wireless Beacon

A NEW wireless beacon is being erected by the Air Ministry at Orfordness, on the East Coast, to serve both marine and air navigation. It will come into operation early next year and it is stated that it will have a range of 200 miles.

NEW RIGID AIRSHIPS FOR THE U.S. NAVY

Two huge dirigibles of 6,500,000 cub. ft. gas capacity costing approximately $8,000,000 will be constructed for the United States Navy by the Goodyear-Zeppelin Corporation, a subsidiary of the Goodyear Tyre and Rubber Co. Contracts for the construction of these airships were signed recently by Curtis D. Wilbur, Secretary of the Navy, and Paul W. Litchfield, president of both Goodyear organisations.

The contract calls for the completion of the first ship within 30 months after construction actually has started, and completion of the second one within 15 months after the first. They will be called the ZRS-4 and the ZRS-5 and will be inflated with helium gas, which is non-inflammable.

The Goodyear-Zeppelin Corporation recently won first, second, and third places in design competition under the United States Bureau of Aeronautics against a number of American and European competitors.

The two Navy ships when completed will be about two and a half times larger than the United States dirigible "Los Angeles," and also bigger than the two British "R" ships and the German "Graf Zeppelin."

A comparison of the ZRS-4 with the Navy's only rigid airship in service at present, the "Los Angeles," is as follows:—

		Los Angeles.	ZRS-4.
Nominal gas volume,	cub. ft.	2,470,000	6,500,000
Length over all ..	.. ft.	658·3	785
Maximum diameter	.. ,,	90·7	132·9
Height over all ..	.. ,,	104·4	146·5
Gross lift	.. lbs.	153,000	403,000
Useful lift	.. ,,	60,000	182,000
Number of engines	.. ..	5	8
Total horse-power	.. ..	2,000	4,480
Maximum speeds, knots ..	..	63·5	72·8
Range without refuelling at 50 knots cruising speed, nautical miles	.. ..	3,500	9,180

It is particularly striking that the new airships will be able to go more than two and a half times as far as the "Los Angeles" without refuelling. Since the function of naval airships is long-distance scouting at sea, the great range of the new ships is of utmost value.

Probably the most outstanding novelty will be provision of a complete aeroplane hangar within the hull of the airship, capable of housing five scouting aeroplanes. The aeroplanes may be lowered on a trapeze swinging through large sliding doors in the bottom of the hangar.

Aeroplanes intended for use with the airship will be equipped with special hooks above their wings for attachment to the trapeze, so that they can be caught while in motion and returned to the hull. Similar experiments, it will be remembered, were carried out with the British rigid airship, R.33.

Externally the new airships will appear fuller and less slender than the "Los Angeles." The lines of the hull will not be disfigured as in past practice by external cars containing the engines. The engines and the engineers will be housed within the hull, reducing the resistance and improving the safety.

The propellers will be supported on brackets from the hull, driven by the engines through transverse shafts and bevel gears.

The hulls of the new airships, like their predecessors, will consist of duralumin longitudinal and transverse girders, with steel wire bracing. The girders will be of a new type, stronger and more efficient than hitherto used.

The outside will be covered with the characteristic aluminised fabric, drawn smooth and tight.

A notable improvement will be the provision of no less than three longitudinal corridors and passageways completely around the circumference of each main transverse frame, giving access to all parts of the ship, so that inspection and repairs can be carried out in flight with a facility never before possible.

In the design of the new airships particular attention has been given to the comfort of the crew. Being naval vessels, they will have no luxurious passenger accommodation, but in habitability for their crews they will compare favourably with cruisers and destroyers. Each will carry a crew of 45 men. Ships of this size, if built for passenger service, would be capable of carrying more than 100 passengers in addition to the crew.

The first step in the construction of the ships will be the erection of a hangar which will be the largest in the world. It will measure 1,200 ft. long, 200 ft. high, and 360 ft. wide.

The plans for the airships were drawn by Dr. Karl Arnstein, vice-president of the Goodyear-Zeppelin Corporation and former chief engineer of the German Zeppelin Co.

During the last 12 years the Goodyear Co. has constructed more than 100 airships for the United States Army and Navy. In 1924 the company obtained the American patent rights of the German Zeppelin Co.

ADVANTAGES OF AIRSHIPS

Lecture to Barrow Engineers

AN interesting lecture on "Airships" and what the R.100 will do, was delivered to the members of Barrow and District Association of Engineers in the Technical College Lecture Theatre, on November 9, by Mr. B. N. Wallis, of the Airship Guarantee Co., Ltd., Howden.

Mr. Wallis referred to the great interest which had been aroused by the trans-Atlantic flight of the German airship, *Graf Zeppelin*, and alluded to Dr. Eckener's remarks on the conclusion of his return voyage to Germany. He was reported to have said that in his opinion the *Graf Zeppelin* was neither fast nor strong enough for the Atlantic service, and he was appealing to the German nation for funds to build a still larger and better airship. The continued failure of the rigid airship to carry out all that its more optimistic supporters claimed to be possible had led to a formation of a very considerable body of hostile opinion both in this and other countries to the continuation of any further experiments with that type of aircraft.

Mr. Wallis said he would try to place the position fairly and impartially before the association with a view to enabling them to form a judgment as to the justification for the expenditure of public money on such projects. It would be generally agreed, he said, that the need for some improved means of communications between the outlying parts of the British Empire and the home country had been established, and the question arose as to which was the most advantageous form of transport to develop for that purpose. The supporters of the heavier-than-air craft must admit that the radius of action of the best passenger-carrying machine was today too small to permit of their operating long-distance air transport lines. As an example, he stated that the extreme radius of action of a modern large passenger-carrying aeroplane did not exceed some 400 ot 500 miles under favourable conditions, and that radius was not sufficient to enable them to begin Empire lines without alighting on foreign territories for the purpose of refuelling.

On the other hand, the airship possessed the great advantage of having an immense radius of action, the *Graf Zeppelin* having actually flown on her journey out to America over 6,000 land miles, her actual distance flown through the air,

owing to the contrariety of winds, exceeding 8,000 or 9,000 air miles.

The airship, he added, also possessed the advantage of being able to carry a relatively large paying load in proportion to its gross displacement. In the opinion of many, all that was required to make the airship a success was an increase of speed to approximately 100 miles per hour and the provision of some safe, reliable, and economical means of propulsion.

Mr. Wallis proceeded to describe in some detail the steps which had been taken in the design and construction of H.M.A. R.100 now approaching completion at Howden, Yorkshire, to attain the desired attributes, and particulars were given of the estimated speed and performance of that ship, together with her general sizes. The length of the airship is 709 ft., and her diameter is 133 ft. Her estimated full speed is 83 m.p.h., and cruising speed 75 m.p.h. There was passenger accommodation for 100 persons, and crew accommodation for 45 persons. The normal radius of action at 75 m.p.h. with extra tankage miles, and the extreme radius of action at 75 m.p.h. with extra tankage in place of paying load was 5,200 miles.

Slides were shown illustrating the various points of the lecture and showing the advances which have been made in the structure of this ship.

A brief discussion followed and Mr. Wallis was heartily thanked for his lecture.

AIRISMS FROM THE FOUR WINDS

Australia-England Flight

THE Ryan monoplane " Spirit of Australia " crashed at Athens on November 26, when taking off for France in the course of its flight from Australia to England, manned by Capt. F. Hurley and Flying Officers Owen and Moir. The machine was almost destroyed and two of the airmen, including Capt. Hurley, were injured. This accident implies the end of the venture started on October 29 at Sydney, Australia, which had as the objective a record return flight between Australia and England within 28 days. There had, obviously, been various delays on the outward route and the month had nearly been absorbed at the time of the crash. There was a delay at Bander Abbas and a slight one at Cairo.

New York-Bogota Flight

LIEUT. B. MENDEZ, a Colombian army pilot, who is flying from New York to Bogota, the Colombian capital, reached Havana, Cuba, from Jacksonville on November 26, having averaged a speed of 110 m.p.h. The next stage of the flight was to Puerto Barrios, Guatemala.

Aeroplane Search

AN aeroplane left Winnipeg, Canada, recently to search for six fishermen who were adrift on icefloes which had broken loose in Lake Manitoba during a gale. A group of men were sighted on a small island six miles off shore, and attempts were to be made to drop food to them until the condition of the ice makes a rescue possible.

Lady Bailey's Progress

ON November 23 Lady Bailey was reported to have arrived at Kano, Nigeria, on her D.H. " Moth " (Cirrus) in the course of her flight from S. Africa to England. Lady Bailey left Kano for Sokoto, via Zaria, on November 27 escorted by Mr. Carpenter, a Nigerian pilot, in his light aeroplane. The flight was resumed on November 17 at Leopoldsville (Belgian Congo) after her slight indisposition.

Wilkins Polar Expedition

A MESSAGE received at the end of last week from Sir Hubert Wilkins at Deception Island stated that the first flights, apparently tests, had been made successfully with the two Lockheed " Vega " monoplanes, which are fitted with Wright " Whirlwind " 220-h.p. engines. The objective of the expedition is to explore by air unknown land extending from Ross Sea to Graham Land round the South Pole.

" Italia " Survivor Returns

MAJOR MARIANO, one of the three members of the *Italia* airship crew who tried to walk to the mainland on North East Island after the airship crashed on May 25, left Stockholm, where he has been in hospital since last August, for Italy on November 24. He had one foot amputated.

Flight-Lieut. P. Murdoch's Flight

FLIGHT-LIEUT. P. MURDOCH, of the S.A.A.F., who flew solo from London to S. Africa in an Avro " Avian " and met with an accident on his return flight, hopes to resume when he has recovered from his injuries. The mishap occurred after he had left Elizabethville and passed over the Congo border. Apparently the machine was badly bumped in an air pocket. Murdoch threw himself out at 50 ft. and the fall was luckily broken by a tree. On gaining consciousness he crawled on his knees for about 10 miles, although seriously hurt, and met natives who sent a message to the nearest white man, Mr. Renaud, at Kasenga, Belgian Congo, who rescued the airman in a canoe.

A " Short " Story

LAST week-end we learned from the daily press how the gale swept triumphantly across the country, razing hoardings, buildings and trees to the ground with consummate ease. It roared round our coasts, washed sea fronts clear of inhabitants and tossed ships about like corks. But the story of how the gale met its Waterloo is a secret left to us to tell. It turned its destructive bent on the River Itchen and there came across a serene wide-spread seacraft riding a stormy surface without fear or tremor, and scorning to run for safety before its devastating march. The gale tossed its mane with derision at this upstart then lowered its head and charged. It met a shocking repulse. Again and again it charged, lifting the long silver craft with spreading wings clean off the water many times, but like a faithful servant it refused to leave without orders, although cruelly buffeted by a force that had demolished houses. Even its top wing was ducked once. Finally, the gale declared an armistice and the Imperial Airways Short " Calcutta " flying-boat rode unscathed and victorious on the River Itchen at Southampton, whilst its enemy scuttled away to seek less formidable foes like a house or two or a few thousand-ton ships !

New Canadian Air Extensions

BRINGING Toronto and Windsor into line with Toronto and Ottawa, Montreal and Quebec in the east and Winnipeg, Regina and Calgary in the west, an air packet express service between the two cities was inaugurated November 13, under the auspices of the Canadian Pacific Express Co.

Where Aviation Pays

THE air mail and passenger service between Montreal and New York, via Albany, run jointly by the Canadian Colonial Airways Inc. and Canadian Colonial Airways Ltd., showed a net profit of $3,000 for October. During the month 35 passengers were carried together with 10,885 lb. of mail, or about 34,200 pieces. A total of 21,877 miles were flown and the gross receipts amounted to about $17,000.

Canadian Air Survey

THE aerial surveying in New Brunswick which was carried out during the autumn by planes of the Royal Canadian Air Force, was completed for the season recently, when photographic work was done at Grand Falls and Edmundston for the Provincial Department of Land and Mines. The work at Grand Lake was completed also and the three aircraft which has been engaged left for Ottawa via the waterway of the St. John River and Lake Temiscouata. Captain Harris was in command of the party.

Air Lines In British Columbia

THE British Columbia Airways, Ltd., has announced its decision to purchase a 16-passenger tri-motored Amphibian plane and two eight-passenger tri-motored seaplanes for a Vancouver-Victoria-Seattle service, to start not later than February 1, and for a Vancouver-Nanaimo-Victoria service later.

The AIRCRAFT ENGINEER

FLIGHT ENGINEERING SECTION

Edited by C. M. POULSEN

November 29, 1928

CONTENTS

EDITORIAL VIEWS

It is not very often that the Editor ventures to monopolise the pages of THE AIRCRAFT ENGINEER. In fact, if memory serves, this is but the second occasion, the first being a description of a somewhat unusual American aircraft design. In the present issue, however, he has fairly taken the bit between his teeth and has occupied more than one-half of the paper in giving a detailed illustrated description of the building, by Boulton & Paul, Ltd., of the main structure of the new rigid airship R.101. Although this has meant holding over a number of summaries of papers read recently before the Royal Aeronautical Society, some summaries of reports and memoranda, etc. (all of which will be published next month), we have tried to make amends by increasing the size of this month's AIRCRAFT ENGINEER in order that the article by Mr. Pollard, giving his impressions of "Metal Construction" at the Berlin Aero Show, and the concluding instalment of Mr. Tinson's article on "The Cheap Single-Seater Aeroplane," might be included.

The Editor feels that the problems incurred in undertaking to build the structure of R.101 were such that all aircraft engineers will be intensely interested in learning as much as possible about the manner in which the various difficulties were overcome, and it is hoped that a study of the article and illustrations will at any rate form an acceptable substitute for an actual visit to the Boulton & Paul works.

If we mention that the standard of accuracy demanded in members was of the order shown below, we doubt that any engineer will be able to refrain from reading the account of how the work was done.

Member.	*Length.* ft.	*Tolerances.* in.
Main longitudinals	45	$\pm 0 \cdot 030$
Frame longitudinals	10	$\pm 0 \cdot 020$
Ridge girders	12	$\pm 0 \cdot 025$
Main radial struts..	11	$\pm 0 \cdot 015$
Interm. radial struts	11	$\pm 0 \cdot 015$
Socketed bracing cables	45	$+0 \cdot 200$ / $-0 \cdot 000$*

* After stretching.

The limits given above were maxima. In actual practice it was found possible to keep within approximately one-third of these tolerances, except for the main longitudinals.

METAL CONSTRUCTION DEVELOPMENT AT THE BERLIN AERO SHOW

By H. J. POLLARD, Wh.Ex., A.F.R.Ae.S.

A visit to the Internationale Luftfahrt Ausstellung in Berlin prompts us to make a further break in the series of articles whilst we review the details and aspects of metal construction as exhibited there.

Practically the first exhibit that caught the eye on entering Hall I was the Dornier stand; this contained a large selection of constructional details and augured well in this respect for the rest of the show, but, unfortunately, the number of separate details shown on other stands was very small. It is thus not possible to give detailed descriptions of groups of components, but even if all the wings and fuselages had been left uncovered it is unlikely that any very new detail would have been exposed to view, with the exception of the wing structure of the M.20, designed and manufactured by the Bayerishe Flugzeugwerke of Augsburg; touching this matter readers are referred to FLIGHT, October 18, 1928, page 8 of the supplement.

We will therefore begin with an examination of the metal aircraft as a whole, turning our attention in the first place to a comparison of the three large monoplanes, the Dornier flying-boat, the Rohrbach flying-boat, and the Junkers aeroplane.

It has been argued in previous articles that as experience widens and knowledge is gained, the most important advantage to be derived from the adoption of metal construction

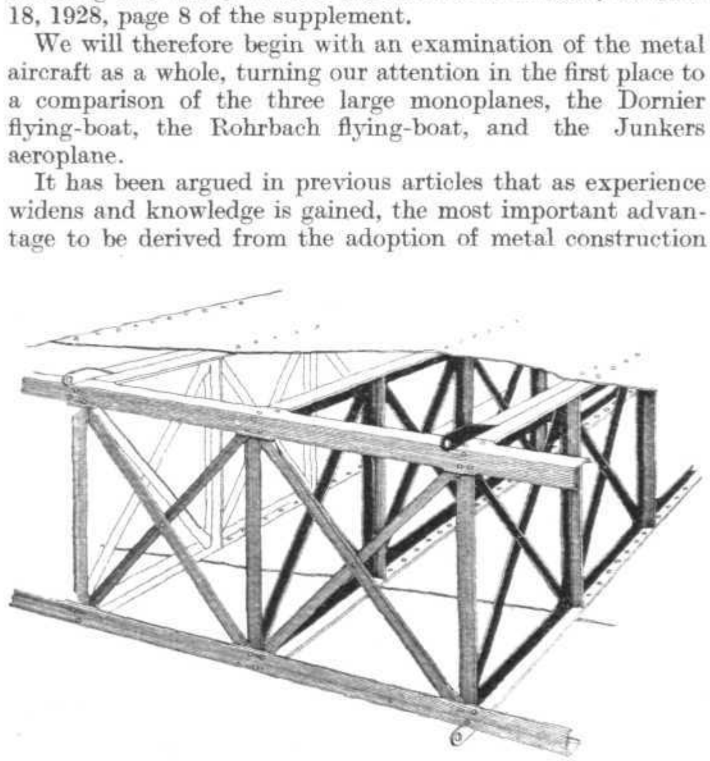


Fig. 1.

will be an increase in the ratio of useful load to gross weight, and that this is likely to be attained by developing the use of high tensile steels. Whether this useful load is of a small weight for dispatch over a great distance, or a heavy weight for dispatch over a short distance, is immaterial: the argument still holds good.

The main particulars regarding the above-mentioned aircraft are shown in the following table.

TABLE I

	Dornier "Super Wal"	Rohrbach "Romar"	Junkers G.31
Type	Braced monoplane flying boat	Unbraced monoplane flying boat	Unbraced monoplane land plane.
Motor	Four 420 h.p. Jupiters	Three 500-700 h.p. B.M.W. VI	Three 420 h.p. Jupiters.
Normal h.p. ...	1,600	1,500	1,200
Span, feet	86·7	121·0	99·5
Length, feet ...	80·6	72·2	54·2
Height, feet ...	19·4	26·2	19·7
Wing area, sq. ft.	1,540	1,830	1,015
Weight, empty, lbs.	16,420	21,800	10,400
Useful load, lbs. ...	14,450	20,500	7,450
Total weight, lbs.	30,870	42,300	17,850
Number of passengers	20	12	15
Wing loading, lbs. per sq. ft. ...	20	23·1	17·6
H.P. loading ...	19·3	28·2	14·85
Top speed, m.p.h....	133	134	128
Useful load/total weight, per cent.	47·0	47·9	41·6

It is an unfortunate fact that a comparison with a large monoplane, land or seacraft, designed and built in this country is not possible for the reason that no particulars of any successful machine of this type have as yet been published Particulars of successful large monoplanes may be available soon, but the fact remains that Germany is able to exhibit publicly large monoplanes of different types while this country is totally unable to do so. The writer has every reason for believing that this position will not remain long unchallenged. What can be done with steel, introducing those refinements of construction that are possible on really large aircraft, opens up a vast field for speculation and ingenuity which may not be pursued now; we will therefore turn

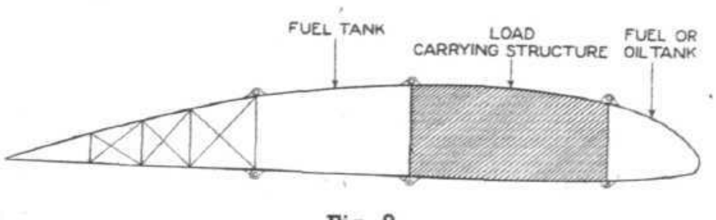


Fig. 2.

resolutely from it, but it is quite likely that we shall resume this subject at a future date. For our purpose we must take things as they are and compare large English biplanes with the above German types. As might be expected, the English type scores heavily when both wing loading and useful load ratio are taken into account, for with a wing loading of only 11 lb. or 12 lb. per sq. ft. large English aircraft have a useful load to gross weight ratio of nearly 50 per cent. If the reader refers to FLIGHT, September 6th, 1928, he will find a description and specification of the Vickers "Vellore." This is an all-duralumin machine of 9,500 lbs. gross weight, a useful load to gross weight ratio of 0·52, a wing loading 6·7 lbs. per sq. ft. a power loading 18·1 lbs. and a top speed of 110 M.P.H. We must bear in mind of course that this is a freight carrier: fitted up as a passenger machine the useful load would be a little less than 4,950 lbs.

Incidentally it may be noted here that German biplane practice seems to be far behind English biplane design. Take as an instance one large German biplane exhibited, the Albatros L.73A. This had a useful load/gross weight ratio of 40 per cent. for a wing loading of 12·25 lbs. per sq. ft. and top speed of 108 m.p.h. Comparison of these figures with those of the Vickers machine shows the superiority of the English design.

Returning to the consideration of the three large monoplanes. In view of what has been seen of the Rohrbach machines in this country it might appear surprising that such a large useful load could be carried in spite of the high wing loading, and we will say at once that this has been obtained principally through great refinements in wing design. For example, the taper of the wing in plan view is from approximately 20 ft. chord at the root to approximately 5 ft. at the tip and from approximately 4 ft. depth of wing at the root to a few inches at the tip. The form of construction of the stress-

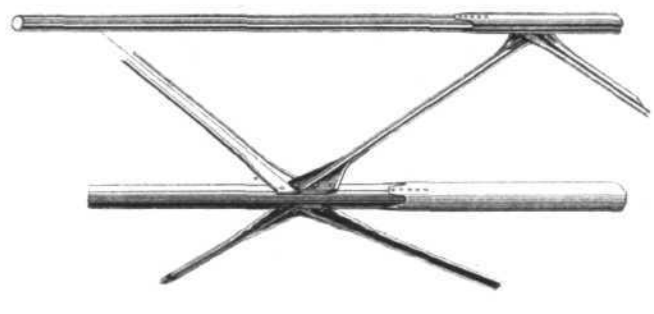


Fig. 3.

carrying portion of the wing was briefly described in the August issue of THE AIRCRAFT ENGINEER. In the case of the "Romar" also this centre portion appeared to be parallel along the whole span, the taper being obtained in the detachable leading and trailing portions. These detachable parts, as well as the ailerons, appeared to be amazingly light. This type of construction is shown in Fig. 1; none of the angles or channels appeared to be thicker than 20 G, and the manner of securing the component angles, channels and skin was very simple. Unfortunately actual weights cannot be quoted. These refinements in design would certainly increase the cost of the "Romar" over the earlier types of construction, but the increase in paying load probably more than compensates for it. Again, the method of carrying the fuel and oil tanks on this machine is most noteworthy: the whole of this load is carried in eight tanks secured to the front and rear portions of the central structural box. The largest of the tanks complete with petrol might easily have weighed 1,000 lbs. This was attached as a cantilever to the main wing structure, the C.G. being at about 15 in. from the points of support. The trailing portion of the wing was attached to the tank at the end furthermost from the points of support, and the whole of the air loads from this were transmitted through the tank to the main beam of the wing. This gives some idea of the extremely unorthodox methods employed in this machine. The arrangement is shown in Fig. 2.

We are so accustomed to seeing very small ailerons on foreign monoplanes that it came quite as a surprise to find the "Romar" fitted with ailerons giving a ratio of control area of the same order as is employed on English types. These ailerons were, moreover, of the "Bristol-Frise" type: the inference from this is that the Rohrbach wing has great torsional stiffness, otherwise the arrangement appears to be inviting trouble.

The torsional rigidity of these large cantilever monoplane wings is a fundamental matter, and any exact information regarding the behaviour of the wings of the "Romar" and G.31 at speed when the ailerons are moved would be most valuable From the nature of the design of the wings of the Junkers machine it is quite easy to see that there must be a great tendency to twist, as the centre of pressure moves from its forward to its backward position or vice versa. A cantilever monoplane wing is, moreover, of the worst possible shape for resisting torsion.

A portion of a Junkers monoplane wing is shown in Fig. 3, and considering the method of securing the bracings, it is obvious that the tubular spars must be subjected to greatly varying torsional forces. The tendency of the spars to twist is, of course, resisted by the skin. Nevertheless, it would be most instructive to know if in actual fact the wing tips of G.31 do remain sensibly free from angular movement. The writer has always regarded the Junkers type of wing construction favourably, but this feature of securing the bracings to the sides of the longitudinal tubes has always appeared to be scarcely an "engineering job," apart from the obvious difficulty of inserting and holding up a rivet in a hole in a portion of a $1\frac{1}{2}$-in. or 2-in. tube, perhaps 10 ft. away from the open end while a head is formed on the outside.

The statement that a finished piece of work is or isn't an "engineering job" is constantly being levelled at the construction of particular parts of aeroplanes: this perhaps occurs most frequently in connection with the fabric covering of a lifting surface. No matter how excellent the structure itself may be in general principle of lay-out and detail design: as soon as it is covered with fabric it ceases to be an "engineering job"!

Can an "engineering job" be defined?

Assuming that the specification is on a sound basis it is clear that the design of a structure should involve considerations of:—

- (*a*) Compliance with the specification regarding strength and weight.
- (*b*) Durability both as regards freedom from corrosion and security against slackening of joints.
- (*c*) Complete immunity from fatigue failures over any period of time.
- (*d*) Ability to withstand severe man-handling.
- (*e*) Ease of repair or replacement of parts if damaged.
- (*f*) Quickness of assembly.
- (*g*) Low initial cost and upkeep.
- (*h*) Ease of inspection.

As to whether a structure is or is not an "engineering job" depends on the number of the above conditions which it satisfies.

It is frequently difficult to give an opinion on first consideration as to whether a structure is an "engineering job" or not, and one's early opinion is often modified as experience is gained in any particular case.

As regards the Junkers wing construction, providing the designer gets the performance he requires and the machine is safe to fly under all conditions, then the fact that the longitudinal spars are subjected to a large number of offset loads is a matter of no consequence, but the question that one asks oneself is how much weight would be saved if all these secondary couples were avoided, and the answer appears to be that if sockets were used the weight, and certainly the cost would be increased, for the saving in weight on the longitudinals would probably not make up for the weight of the sockets. It might well be that the weight of the Junkers wings could be substantially reduced by using metal strip. It was interesting to note that in the centre section, where the loads are greatest, sockets round the tubes were used as a means of securing the bracings.

We have seen that the wing loading of this particular machine is 17·6, while the figure for passenger machines of English design is only 10 or a little more. Allowing for the larger K_L max. of the G.31, the Imperial Airways machines have one great advantage over the Luft Hansa land aircraft, which will no doubt appeal to the air travelling public, since the majority of passengers would probably prefer to take four hours on a journey and land at 50 m.p.h. rather than three hours and land at 75 m.p.h., particularly while the possibility of forced landing still exists.

Returning to the Dornier exhibit, there is not much here that can be dealt with in detail; as stated at the beginning of these notes, there were a large number of tested structural specimens on the stands, but since no particulars of lengths, sections, dimensions or failing loads were available, these specimens were more imposing than instructive. One saw confirmation in one test, however, of the necessity for having considerable strength reserve in the joints of tension members of bracings. When an open girder is tested to destruction, in the event of a tie member failing, the damage usually is not confined to the tie, the booms being invariably very badly damaged, since they have to take the whole load in shear. On the other hand, however, if a strut fails in compression, the damage can usually be made good, and after repair the test can be continued. The reason why a compression failure is not so serious is because the load is momentarily relieved when the bracing "gives" and even after the commencement of buckling the member may withstand three-quarters of the original load; at any rate, it is not usual for the whole of the shear load to be thrown on to the booms after buckling of a bracing compression member; moreover, there is often visual evidence

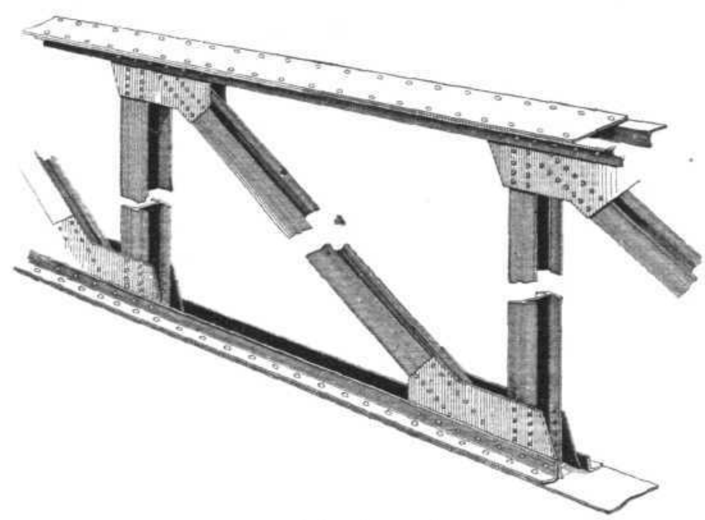


Fig. 4.

of the likelihood of a strut failure because of the bowing of the strut. The load in a tension member may be estimated with accuracy and sufficient metal be provided for carrying it; the trouble comes at the "rigid" riveted joint where the stress distribution may be very indeterminate and localised high stresses may start a failure which may spread across the whole joint with catastrophic results. There is also usually little previous warning that a tie failure either at the joint or in the member itself outside the joint is impending.

One such girder spar having a fractured tie was on view, and the booms were damaged beyond repair, while close by a similar spar having a buckled compression member was shown; in this case the place of failure was not at first apparent, and repair was obviously an easy matter. In later developments of Dornier spars it was noted that great precautions were taken that the joints of tension members were right.

A specimen of a large girder spar about 3 ft. deep was also on view. This was built on standard structural engineering lines, the material was $\frac{1}{2}$ in. thick or thereabouts in places and rivets that appeared to be of about $\frac{3}{8}$ in. diameter were used. A sketch of this is shown in Fig. 4.

The Dornier wing construction approximates most nearly to English standards inasmuch as there are two main spars and in some special cases a subsidiary spar. These wings are, of course, braced externally, the struts being set at a very small angle to the horizontal, thus relieving the bending moment in the wings at the expense of added end load. On one type of Rohrbach machine, external struts were used, but it is understood that the water resistance of the lower ends of these struts handicapped the machine in "getting off." Dornier gets over this difficulty by terminating these external struts on two lower wings of small span; these wings act as stabilisers in the water, and also must help the machine in the take-off.

The relative merit of pure cantilever and "semi-cantilever" monoplane wing structures is a subject which obtrudes itself at this stage, but the discussion of this important matter must be deferred to a later article.

As to the other Continental exhibitors. The Italian and Belgian stands had some samples of Duralumin work on view. In both cases this was of quite an elementary nature, and it was stated that the specimens shown were still the subject of research. Nothing is missed in not describing in detail any of this work; the main theme of development adopted lies in using square Duralumin tubes with the sides liberally lightened. A tail plane and elevator of Belgian design was composed wholly of such tubes held together by light brackets. The tubes were of an assorted variety, some being solid drawn, others made from one piece of sheet, one corner terminating with a tinsmith's joint. Larger tubes were made up from four separate pieces. These were all first efforts, and as first efforts they were very good indeed.

There was plenty of evidence of the employment of German engineers on aircraft in Soviet Russia. Some of the wings shown were clearly built on Junkers lines. Parts of a fuselage were of Dornier type. Welded tubing also was in evidence on their exhibits. It was seen from these exhibits that the Russians are obtaining experience with every type of Continental construction.

The Heinkel Company had elementary forms of metal construction on view. Some of the spars were similar in type to Dorniers (*see* FLIGHT of October 18, page 2, special supplement), while the ribs were of welded tube of very small diameter. One cannot conceive welded tubular ribs comparing at all favourably in weight with ribs of other constructions.

German methods of making structural tests on aircraft were shown in considerable detail on one stand; this has evidently been the subject of much thought, yet one missed those refinements in methods of testing which are well known in this country. Exception to this statement may perhaps be made in favour of the German apparatus for testing wheels and shock absorbers: this was a very elaborate machine.

Metal construction of aircraft does not, of course, end with the load-carrying structure. The most difficult part of an aeroplane to produce efficiently and cheaply in metal is the propeller. Various attempts have been made to produce satisfactory metal propellers, the duralumin ones probably being the most successful, but it cannot be said that this problem is as yet satisfactorily solved. A hollow blade is obviously the prime necessity, and this appears to have arrived in the Haw steel-magnesium construction; a hollow "magnesium" blade is cast and the tension forces are taken on two internal bars per blade. These bars are tapered and screwed at intervals corresponding with transverse ribs in the casting, nuts on the steel bars being screwed up tight on either side of these ridges. The sketch shows a portion of one of these blades. Inspection doors are secured to the blades at the position of lock nuts, as shown in Fig. 5; each separate blade is secured into a steel hub so designed that the pitch of the blades can be adjusted. A clever device shown near the propeller stand was a new form of coupling, called the Rupp Hub, which eliminates the necessity for boring a number of holes straight through a propeller boss and the subsequent tightening of a number of separate nuts; a sketch of the device is shown in Fig. 6. A number of projections register in the holes in the prop. boss, these holes only being bored a short distance through the boss. The greatest virtue of the invention, however, lies in the fact that only one single large nut needs tightening, the pressure being evenly applied through the cone as shown.

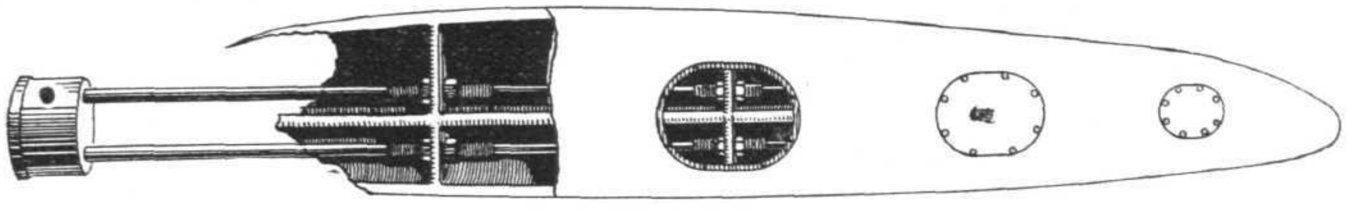


Fig. 5.

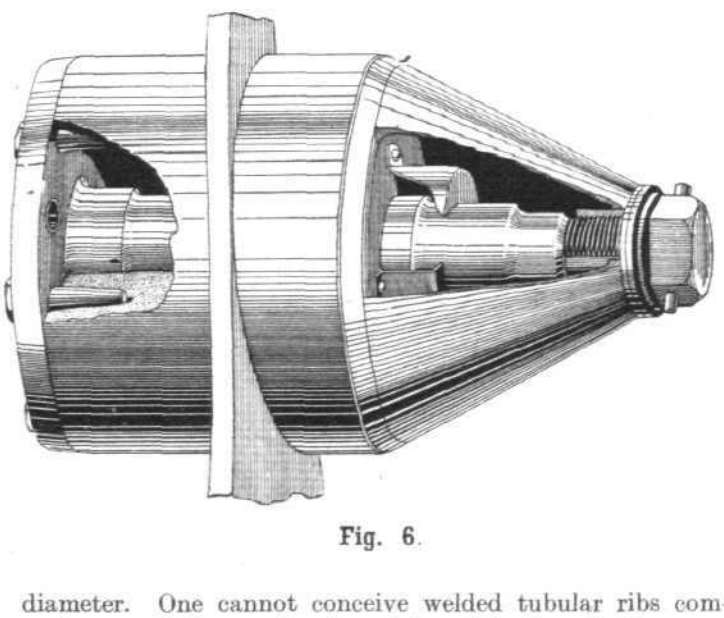


Fig. 6.

The value of exhibitions such as the Internationale Luftfahrt Ausstellung as a medium for interchange of ideas cannot be over-estimated, and the time cannot be far distant when they will have direct monetary value to the exhibitors. This interchange of ideas can have its dangers however: some exhibited methods of construction may make a strong appeal to us, but the immediate adoption of any particular method without a thorough investigation into why it was adopted in the first place and, also, in what respect other features of the aeroplane are affected: parts apparently having no bearing on the detail that has taken our fancy may easily lead to trouble. The fascination of these exhibitions in fact, lies in searching out for that which appears to us peculiar and unusual, and by approaching each particular case with a perfectly open mind, if in addition it is assumed that the exhibitor knows his job at least as well as we know ours, then we are in a fair way for deriving the greatest good from these shows.

German technical notes are detailed and not easy to follow unless one has had special practice in this branch of the language. I have, in consequence, to thank Capt. Bartlett, of the Bristol Company, for much help in this direction. It is also noted that he succeeded, after the show had started, in having the "Bristol" stand moved from a position of obscurity to one of prominence.

LIGHT SINGLE-SEATER AEROPLANES

By CLIFFORD W. TINSON, F.R.Ae.S., M.I.Ae.E.

(*Concluded from p.* 77)

Performance.

With this design and 26-H.P., the following performance figures were expected, a performance sufficiently high to allow a large margin for additional structure weight or overload in the shape of a larger petrol capacity without reducing the rate of climb and get-away to such a point that the utility of the machine would be in jeopardy.

The maximum speed would be in the neighbourhood of 104 m.p.h. were the machine of normal proportions, but owing to the relatively large cockpit opening in comparison to the

diameter of the body, 10 m.p.h. has been deducted from this figure.

Surface loading	8·33 lb./sq. ft.
Power loading	15·38 lb./H.P.
Maximum speed at ground level ...	94 m.p.h.
Minimum speed	52 ,,
Rate of climb at ground level ...	600 ft./min.
Service ceiling, at least	10,500 ft.
Absolute ceiling, at least	13,000 ft.

This performance would have been considered reasonable and would have permitted the use of fields of moderate dimensions —there being no club aerodromes then, of course—and together with Bert Hinkler, who was very attracted by the conception and possibilities of the scheme, it was decided to make an attempt at building a machine.

The scheme fell through, however, for various reasons, the principal ones being the engine and propeller questions and to some extent a doubt as to the airworthiness in any but calm weather of such a small machine.

The engine, we felt, should have had dual ignition, and this the makers could not readily fit to the standard engine. Then there was a question of a propeller for 3,000 r.p.m., which has since proved itself to be no difficulty at all. We half expected, however, that mysterious unforeseen factors might arise owing to the high rotational speed for a normal forward speed which would probably reduce the efficiency so much that our "standard" of performance would never be reached. Lastly, there was the probability that so small a machine would be perfectly hopeless in anything but a dead calm, which would have reduced the utility of the machine very seriously.

Now as regards the price, I did not estimate in detail for the complete machine, as we had decided not to go on with it, but before making this decision I had completely estimated the cost of material for the wings and ailerons, and also had a quantity of data on prices of materials generally, and of items (engine, wheels, etc.) which would be purchased as units.

As shown previously, the price of the material for the wings and ailerons, not including any allowance for scrap and waste, was £7 7*s.*, which, if doubled for labour and increased in a fair proportion to cover establishment charges and scrap, gives a selling price of, say, £22 10*s.* for the wings and ailerons, or 9*s.* 4¾*d.* per square foot, comparing favourably with the best prices for wings when they were being made in huge quantities during the war.

The price of other components was proportionally low, owing to the very small size of the machine, and as far as I can remember we came to the conclusion that the material for the complete machine, *including the engine*, would have cost us somewhere between £125 and £150, inclusive of scrap.

Taking the higher figure, it looks possible to produce a single seater to sell at £300 at a handsome profit if one could buy an engine for £42 less 10 per cent., and therein lies the snag.

It will also be said now that two gallons is far too little fuel to carry, so that, apart from any increase in size necessary to provide accommodation for a more reasonable quantity, the additional weight of fuel required would put the weight of the machine up by at least 60 or 70 lb., and it would therefore be necessary to increase the span a little because the landing speed of the design as it stood was already rather too high.

Subsequently, in January, 1927, the idea was further developed, this time with the "Bristol" Cherub engine as the basis. In this design, shown on the left in the set of drawings published last month, it was intended to commence with 3¾ gallons of fuel, the stress weight being sufficient to permit a larger quantity to be provided if necessary.

The following are the estimated weights :—

	wt. lb.
Top wings, 48·75 sq. ft.	58·5 with struts.
Bottom wings, 32·50 sq. ft. ...	39·0 ,, ,,
Centre plane, 4·50 sq. ft. ...	6·75
Tail and elevators, 14 sq. ft. ...	17·50
Rudder and fin, 6 sq. ft. ...	7·50
Undercarriage	22·00
Fuselage and engine mounting ...	30·00
Petrol tank	6·50
Petrol, 3¼ gallons at 7·6 lbs. ...	24·70
Oil, ½ gallon	5·00
Controls	6·50
Engine	100·00
Propeller	11·00
Tail skid	2·00
Pilot	140·00
Seat and floor	3·50
Cowling	5·00
Estimated total	485·45 lb.
Weight for stressing	550 lb.

This design departs somewhat from the original one in that it is a biplane having fabric covered wings, external struts and wire bracing, and there are therefore a larger number of items comprising the complete aeroplane.

While it is not quite as small as the original design, it is not without interest to find that a machine of practically identical wing area and dimensions generally, with a Cherub engine (the Powell biplane) was built in America, and particulars published about a year ago, and one formed the opinion from the published accounts that it was considered to be a practicable flying machine in spite of its small size.

There was also the Grain "Kitten" of 1916, a machine which as far as I can remember was of about 15 ft. span, and which gave very excellent results.

There is evidence to show that it is practicable to build down to a size which is promising from the point of view of the £300 machine, and in my opinion it is possible so to simplify the construction as to make it feasible by sacrificing a certain amount of weight, provided that one obtains an engine of about 30 h.p. at price of say £65.

As the American machine referred to above was, I believe, an amateur effort, it would be interesting, should this discussion catch the eye of Professor Powell, who, I understand, is in England at the present time, to hear what he has to say about the cost of building his machine and about its airworthiness. Another very small machine about which he may have some data is the Kreider-Reisener, which I am told was smaller still. Perhaps the Light Aeroplane Club fraternity may care to say something on the matter.

In conclusion, the £300 single-seater does look possible if the price of the engine is right, and it is not too much, perhaps, to hope that the popularity of light aeroplanes at the present time may inspire some manufacturers to see what can be done to provide a power unit at a price low enough to make an attempt at a £300 machine worth further consideration.

BUILDING THE STRUCTURE OF R.101

By the Editor

Most readers of Flight will probably have a fairly good idea of the general design of the new 5,000,000 cub. ft. rigid airship R.101, which is now being erected at the Royal Airship Works, Cardington, Bedfordshire. They will know that this is by far the largest airship ever built, not only in this country but in the world. They will know, from the paper read by Wing-Commander Cave-Browne-Cave before the Royal Aeronautical Society recently, that the engines are to be of the Beardmore heavy-oil type driving variable pitch propellers, and they will know, at least in a general way, that fuel and water is to be stored in tanks spread around the interior of the airship and capable of being transferred to any desired point by powerful blowers.

Of the actual structural details of R.101, however, the general public has hitherto been told relatively little, and nothing at all of the problems that arose in producing the structure once the general design had been decided upon. With other representatives of the technical press the Editor of The Aircraft Engineer was permitted to see at Norwich last week exactly how the various types of girder have been

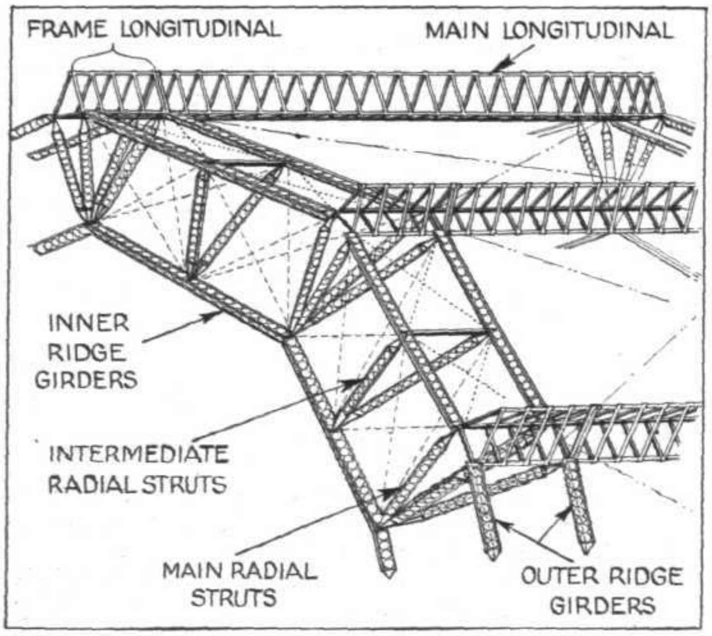


Fig. 1. Sketch showing, diagramatically, the main structure members of R. 101.

produced, from the initial stage of soft flat strip to the finished girder section ready for transport to Cardington, there to be raised into position on the airship and bolted in place, without any fitting being done *in situ*.

As the whole subject is so obviously one of aircraft engineering, and quite exceptional aircraft engineering at that, it has been decided that the notes which follow will not be likely to appeal to general readers of FLIGHT, being necessarily of much too technical a nature. Consequently we have decided to place this outline of the building of the main structure of R.101 in the pages of THE AIRCRAFT ENGINEER, which has been greatly enlarged this month in order to enable us to place on record an appreciation of the very wonderful piece of engineering achievement which the building of this remarkable structure represents.

Before going into detail concerning the various types of girder, &c. of which the main structure of R.101 is composed, it may be helpful to give a very brief outline of the general principles adopted in designing this airship, as in that way it will be easier for readers to realise the problems involved and to appreciate the ingenious ways in which they were tackled by Boulton & Paul, Ltd.

Keynote of the Design

It is difficult, in dealing with a relatively complex structure such as that of a large rigid airship, to point to any one feature and to say that this forms the basis of the whole design. In the R.101, however, although this airship incorporates a large number of unusual features, it is probably permissible to regard as the keynote of the design the employment of rigid transverse "rings" or frames. In previous rigid airships it has been customary to use transverse frames which were not in themselves stable structurally and had to be braced by wires or cables. The "rings" of R.101 are self-sufficient structures in that they have been so designed that no radial wires are required in the plane of the "rings" and running to a single point in the centre of the polygon formed by a transverse section through the airship. To obtain the necessary structural stability without using cable bracing it was necessary to make the "rings" or frames very substantial, and ultimately a type was evolved composed of triangular section girders in which there are two girder members on the outside, known as the "outer ridge girders," and one member on the inside, called the "inner ridge girder." These ridge girders (outer and inner) were then connected by members known as radial struts (main and intermediate), and the whole braced by cable so as to preserve the shape. The arrangement may be followed by referring to the accompanying diagram (Fig. 1). To the outside of the frames thus formed were attached the longitudinals which give the airship its streamline form, and which carry the outer fabric covering or envelope.

This fundamental "scheme" having been decided upon, the next problem was to decide upon a method of joining to each other and to the longitudinals the ridge girders forming the sides of the polygon. In the Zeppelin airships, apart from the difference in the details of the various girder members, the fore and aft girders are riveted to the "rings" or frames, forming a structure which is statically indeterminate because the end conditions are not known with any degree of certainty. This it was decided to avoid, and in any case the tubular booms used so extensively in R.101 could not well be joined by riveting, even had it been desired to do so. In view of the

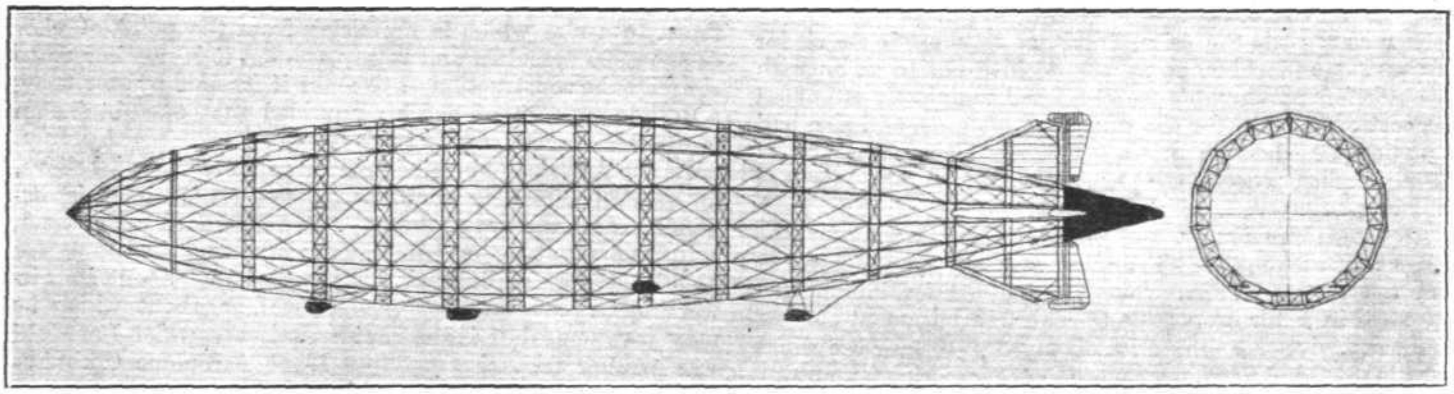


Fig. 2. Outline of R. 101, showing members made by Boulton & Paul.

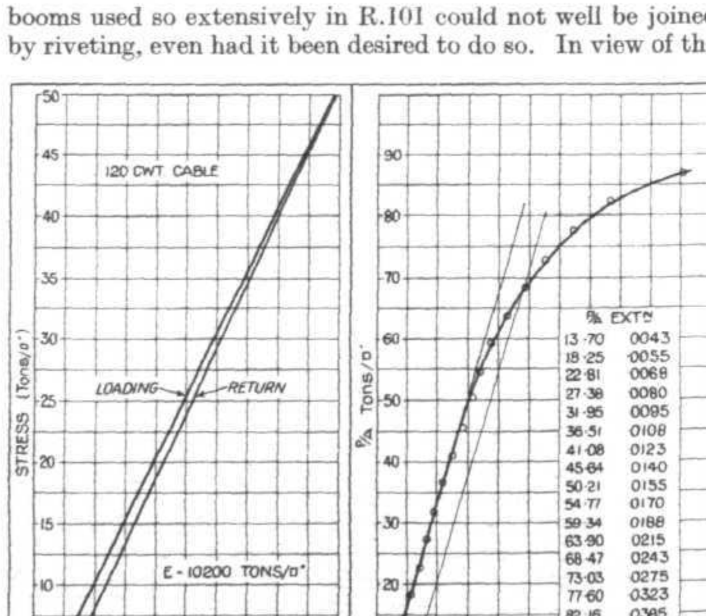


Fig. 3. On left, stress-strain diagram of bracing cable, and on right, stress-strain diagram of stainless steel strip.

fact that the actual construction was to be done at the Boulton & Paul works at Norwich, the Royal Airship Works at Cardington to do erection only (as regards the main structure), a form of bolted joint was chosen, of such a type that a complete ridge girder could be assembled at Norwich and sent to Cardington.

The main longitudinals obviously had to be built in sections, being much too long to be transported as a whole, even if they could have been so manufactured. The logical thing seemed to be to divide the longitudinals at the "rings" or frames, and this was actually done. Over the outside of each frame corner is placed a relatively short length of fore-and-aft girder known as the frame longitudinal. This member is to be regarded as a part of the transverse frame, and to its ends are bolted (during the erecting process) the ends of the main longitudinals. The diagrammatic sketch, Fig. 1, will probably make the arrangement clear.

& Paul, experimental sections of the airship were constructed for the purpose of proving the methods of detailed construction, and also the type of stiff transverse frames evolved by Cardington. The various structural members developed by Boulton & Paul gave good results on test, and the complete test bay was erected at the Royal Airship Works and tested with entirely satisfactory results. Then, and not until then, the contract for the complete hull, fins and rudders of the airship was entrusted to Boulton & Paul, who built the following special classes of members: Main longitudinals, frame longitudinals, ridge girders, radial struts, shear wires, floor bearers, and all the necessary joints for connecting these members together.

Types of Girder Used

Generally speaking, two main types of girders have been used in the structure framework of R.101, both developed by Boulton & Paul, Ltd., and made possible by the long

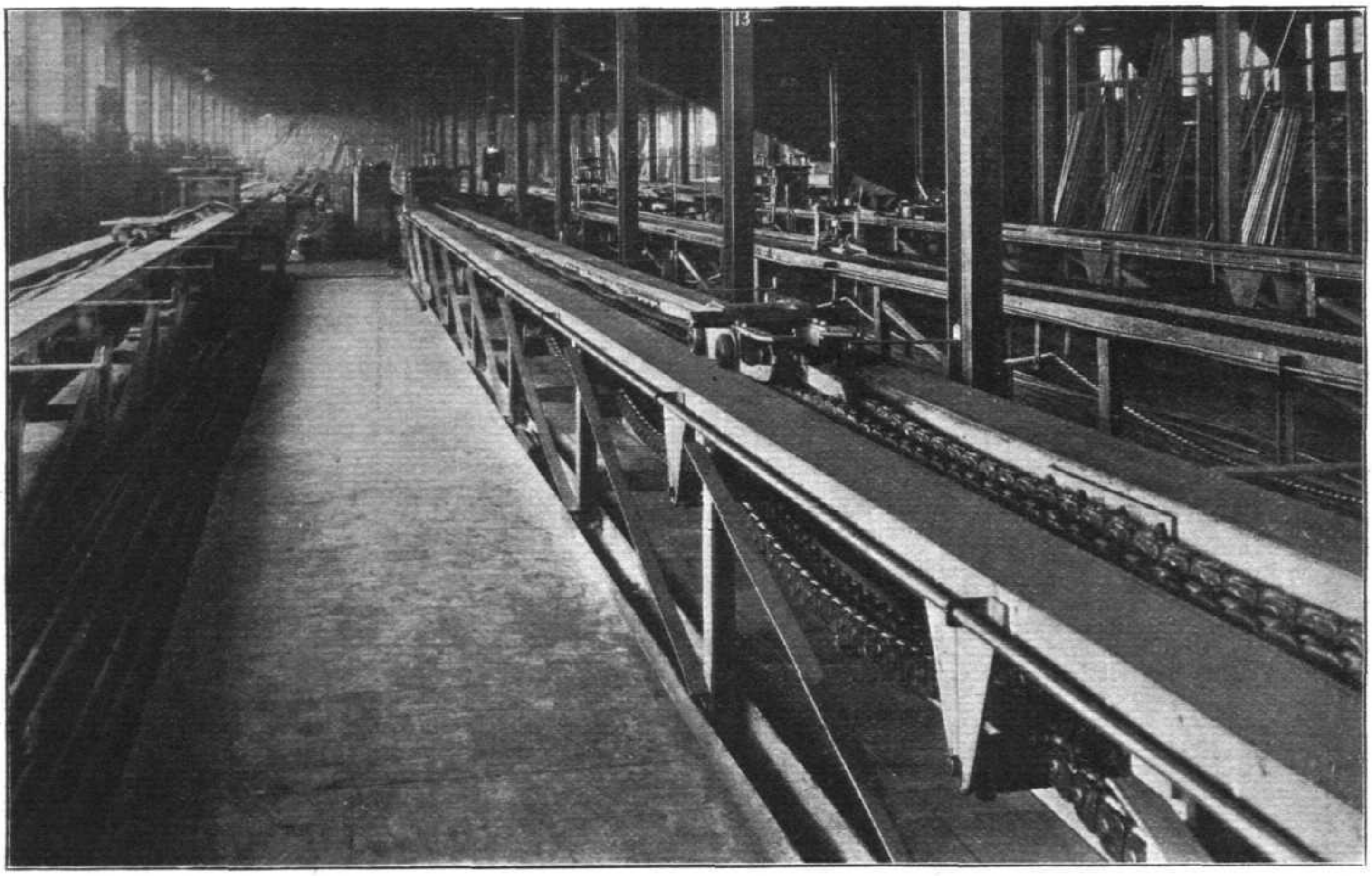


Fig. 4. View of the four drawbenches in the Boulton & Paul Works.

Division of the Design Work

Having thus completed, as it were, the single-line diagram of the main structure of the airship (shown in Fig. 2), the designing office of the Royal Airship Works at Cardington carried out the stress calculations, supplying the loads in various members to the Boulton & Paul designing office, which used the geometry and loads thus made available to convert the line diagram into an actual structure. The very closest co-operation between the Royal Airship Works and the Boulton & Paul works was obviously necessary, and Mr. J. D. North, chief engineer and designer of Boulton & Paul, was appointed to act as consultant in metal construction to the Director of Airship Development. The detailed geometry of the design had to be calculated to fifteen significant figures, and the difference of the spacing of the strut joints on the inner and outer longitudinal booms, as well as the overall lengths of these booms, were calculated by using arcs of circles for each main and frame longitudinal, the main longitudinals being between 1° and 2° of an arc having a curvature of the order of a quarter of a mile radius.

Before the actual manufacture was commenced, and in fact before the order for the structure was placed with Boulton

previous experience of the firm in the design and construction of all-metal aircraft of the heavier-than-air type. These two types of girder are used in the main longitudinals and frames, respectively. Variations of the two have been employed in certain cases, as dictated by local considerations, but in the main the two types may be said to be characteristic of the structure. The "rings," or transverse frames, are composed of compression members stabilised by cables, the compression members being, generally speaking, built up of "bulb-section" steel booms with Duralumin webs. The radial struts are of similar design, but as the loads in them are considerably smaller, the booms as well as the webs are made of Duralumin.

The fore-and-aft members of the structure, arranged as are the frame members to form triangular girders, are composed of tubular booms and struts, braced by cable, but the booms are of a different type, owing to the absence of the Duralumin webs used in the girders of the frames. These booms have been developed by Boulton & Paul after considerable research, and are used extensively by them as longerons in the fuselages of Boulton & Paul aeroplanes. They have become known as "closed-joint" tubes, and are

manufactured from flat strip, which is formed in the soft state into tubes, and afterwards heat treated. The actual process of forming will be dealt with later, but here it may be stated that it was the large amount of research work previously carried out by Boulton & Paul which made possible the use of stainless steel members in the airship.

Joints

The main and frame longitudinals have been made to join together with close-fitting bolts in such a way that no fitting is required during the process of erecting the airship. In the wire bracing of the main longitudinals, use has been made of a special type of shackle which straddles the boom and is attached to it by bolts. This forms a very neat joint, and may be seen in some of our photographs. The shackles were received as stampings, and the work done on them will be dealt with in detail later.

Fairly complicated stampings are employed in connecting the transverse frame members to longitudinals and radial struts, and again the details of the work done on them are contained in a later section of these notes. Here, it will suffice to point out that the main shear bracing is carried on a joint in the frame longitudinals, situated approximately on the neutral axis, and that the changing angles of members at almost every joint necessitates extremely accurate machining and drilling.

The radial struts have their ends housed in sockets, these sockets being supplied to Boulton & Paul in the form of die castings, which have to be milled and drilled to take up a series of varying angles around two main axes. The actual shape of these sockets is seen in the photographs which illustrate the operations performed on them and the jigs employed.

MATERIALS AND THEIR TREATMENTS

Before entering upon an account of the two main problems in the construction of the structure of the R.101: the forming of members such as tubes and bulbous booms, and the assembly of these into girder units, it may be of interest to give the specifications, etc., of some of the materials employed, since by so doing one obtains an even better idea of the difficulties which had to be overcome.

Stainless Steel Strip.—The closed-joint tubes used in the main longitudinals, and formed on drawbenches, with subsequent hardening and tempering by the Boulton & Paul continuous heat-treatment process, have the following composition:

Carbon	0·16—0·22 per cent.
Silicon	Not exceeding 0·5 per cent.
Nickel	Not more than 1 per cent.
Chromium	12·5—14 per cent.

This steel was specified after some two years of research work carried out in the experimental department of Boulton & Paul, Ltd. Steels in this range, after hardening from a temperature of 960° C.—1,000° C., and tempering at a suitable temperature, have the following mechanical properties:

Proof Stress	Not less than 65 tons/sq. in.
Ultimate Stress ...	88—95 tons/sq. in.
Close bend (transverse)	$3 \cdot 0 \times t$.

A typical stress-strain diagram is shown on the right in Fig. 3, the chemical composition of the particular material being: C, 0·19 per cent.; Si, 0·41 per cent.; Mn, 0·27 per cent.; Cr, 13·93 per cent.; Ni, 0·22 per cent. E = 13,000 tons/sq. in.; proof stress = 68 tons/sq. in.; ultimate stress = 95·5 tons/sq. in.; bend = 2·9 t. Proof stress is defined as that stress at which the stress-strain diagram departs from the straight line of proportionality by 0·1 per cent. of the gauge length.

Stainless Steel Sheets and Plates for Fittings, Wiring-plates, &c.—The steel chosen for these was an Austenitic steel relying for its mechanical properties on cold work. A typical composition is:

Carbon	0·14 per cent.
Silicon	0·36 ,,
Nickel	10·00 ,,
Chromium	16·10 ,,

Typical mechanical properties are:

Proof stress	50·25 tons/sq. in.
Ultimate stress	58·74 ,, ,,
Elongation on 2 in.	28·5 per cent.
Close bend on 16 g.	Flat both ways of grain.

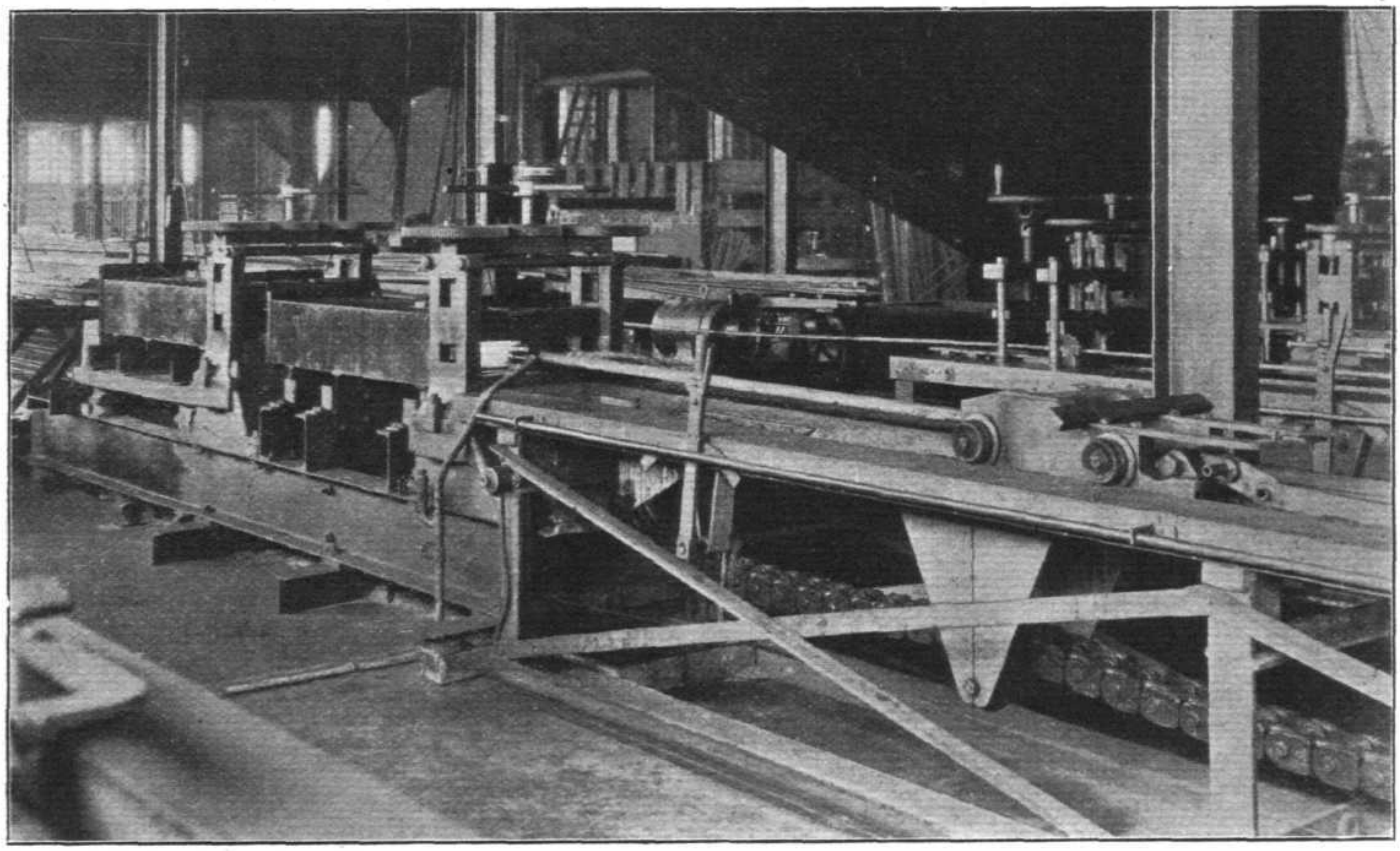


Fig. 5. A close-up view of one of the drawbenches.

The proof stress on this material is defined as that stress at which the stress-strain diagram departs from the straight line of proportionality by 0·5 per cent. of the gauge length.

Solid-drawn Steel Tubes.—For the first time in aircraft practice, Boulton & Paul have employed hardened and tempered solid-drawn high-tensile steel tubes for structural work. The tubes are of the typical composition employed for T.2 (axle) tubes, and they have been heat treated to give the same mechanical properties as the patent Boulton & Paul closed-joint tubes in stainless steel. Solid-drawn stainless steel tubes were not available; the bulk of such tubes is represented by the thin walled and large-diameter tubes $2\frac{1}{4}$ in. by 21 g. and $2\frac{3}{4}$ in. by 20 g. It will be realised that formidable practical difficulties had to be overcome to heat-treat such tubes and keep them true to section. The mechanical properties were: Proof stress, minimum, 65 tons/sq. in. ultimate stress in the range 80—90 tons/sq. in. Close bend (transverse), $5 \times t$.

Die Castings.—Many thousands of die castings in the 10—14 per cent. aluminium silicon alloy have been used. These are cast with great dimensional accuracy, and the castings are sound and of remarkable ductility. The specified mechanical properties of the chill cast 1-in. test pieces are:

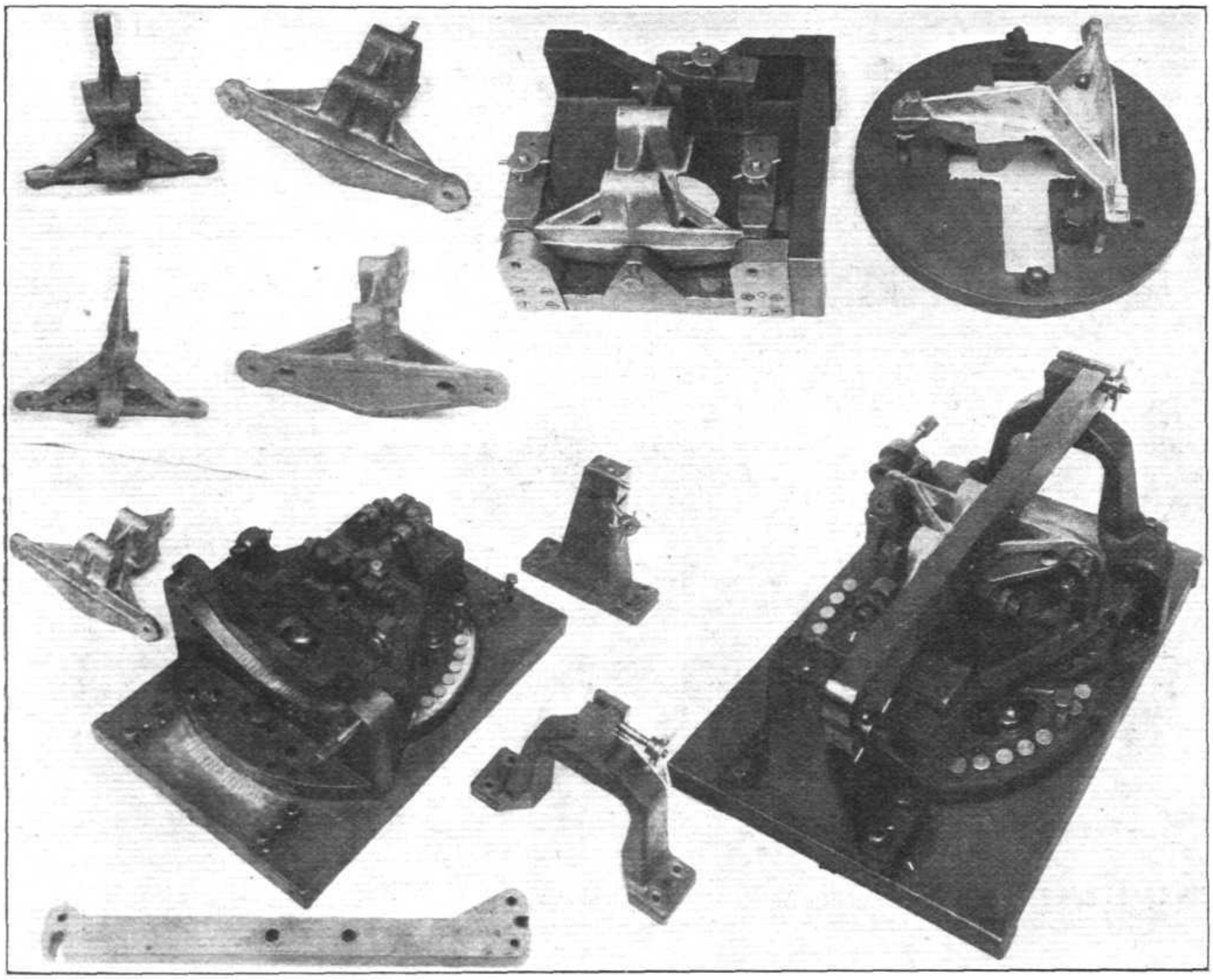
Ultimate tensile stress not less than 12 tons/sq. in.
Elongation on 2 in. not less than 7 per cent.

Steel Stampings.—Only high-tensile, heat-treated stampings have been employed, a minimum ultimate tensile stress of 55 tons/sq. in. being specified.

Duralumin.—This material has been employed in its heat-treated and fully aged condition for certain members such as closed-joint and solid drawn tubes, bulbous booms, and flat sheet webs.

Zinc-Cadmium Solder.—It may appear somewhat remarkable to include a solder as an important item among the materials used in the airship, but the particular use to which this solder has been put makes it actually a very important part of the structure. The bracing cables of R.101 are provided with a type of end fitting which not only has to provide an anchorage for the cable but also a means of adjustment of length. The type of fitting adopted houses the end of the cable in a cone-shaped socket, and solder is used to form, with the splayed-out ends of the strands of the cable, a solid cone strong enough to prevent the cable from pulling through. Consequently it became necessary to find an alloy of low melting point and of sufficient shear strength. Eventually the Cadmium-Zinc eutectic was chosen, and this has proved an unqualified success. The chemical composition is: cadmium, 82·6 per cent.; zinc, 17·4 per cent. The melting point is 263° C., and the shear strength as solder 7·0 tons/sq. in.

The advantages of this alloy for the particular duty are: (1) that it is strong enough in shear not to extrude under full load; (2) that it is of such low melting point as to provide a very ample margin of safety in manufacturing as far as the mechanical properties of the cable and the end fittings are concerned; (3) that it can be used to make a perfect end with (*a*) galvanised cable, and (*b*) zinc-protected end fittings, without the use of any acid or chloride flux—a very little rosin being sufficient. Cadmium is very closely related, chemically, to zinc, and it will be appreciated that the use of this alloy has reduced the risk of corrosion from electrochemical



Figs. 6, 7, 8 and 9. These views show an outer ridge main joint stamping in four stages, *i.e.*, in the rough, ready to mill angular lugs, lightened, and finished. Also jigs for spot facing, milling lugs at vertices of triangle, drilling, and milling and drilling main lugs.

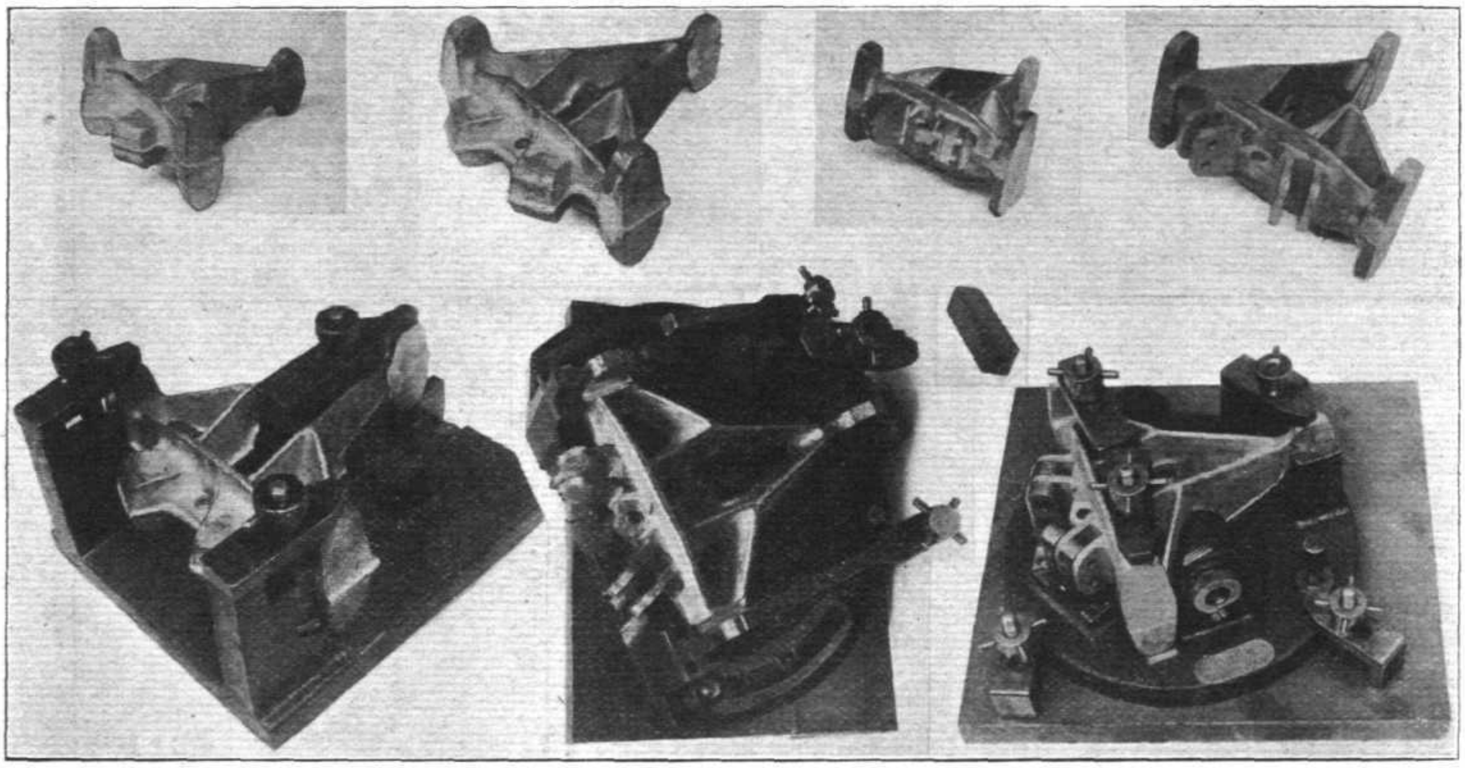
and other causes to an absolute minimum. Incidentally, it may be mentioned that the alloy has been made in the Boulton & Paul foundries, under control of their laboratory staff, and that it is known in the works by the contraction "Cazin."

The Bracing Cables.—In dealing with the problem of the most suitable form of cable bracing and end fittings, the following three requirements had to be considered: (*a*) lowest possible weight; (*b*) largest possible apparent value of Young's Modulus "E" of the cable complete with end fittings; (*c*) reliability of the end fittings. In this connection it seems worth while mentioning that many years ago, around 1913-1914, Mr. J. D. North, who was at that time chief engineer to the Graham-White company at Hendon, made use of soldered splayed cable ends in cone fittings on some of the machines he designed, and that the success then attained in a small way may conceivably have encouraged him to try the same idea in an improved manner on the much more severe conditions that may be expected in a structure as large as that of R.101.

of smaller ropes. The 135-cwt. straining cord consists of 1 × 37 strands, whereas the 150 cwt. and upwards consists of 7 × 7 strands. As a result of this low value of "E" for the larger cables, no single cable larger than 135 cwt. has been used, duplicate cables being used where a greater size was required. A typical example of the stress-strain curve obtained from the tests is shown on the left in Fig. 3, illustrating the hysteresis effect.

In order to discover possible "creep," a number of cables were suspended and dead weights hung on and left for long periods. A typical result is as follows: a 45-cwt. cable loaded with 11 cwt. for 282 hours "crept" 0·065 in. on a total length of 99 in. This extension was recorded after a few hours, no further "creeping" being recorded.

In order to check the reliability of cables and end fittings, a number of each size of cable was made up and tested to destruction. The result showed that the actual strength of the straining cables was in almost all cases about 8 per cent. in excess of its nominal breaking strength, and in no case did a cable or end fitting fail at less than the nominal load. Out of



Figs. 10, 11, 12 and 13. Above, four stages in operations on inner ridge main joint stampings: Prepared for locating in jig, side lugs milled, top jaws milled, and finished stamping. On left, stamping in first milling jig. In centre, stamping in top jaw milling jig. On right, stamping in top jaw drilling jig.

Before deciding on the final type, exhaustive tests were made by Boulton & Paul on cables complete with end fittings. The tests were designed to aid in determining the following three main considerations: The value of "E"; the possible "creep" under sustained load, and the reliability.

Unfortunately, space does not permit of giving details concerning these various tests, interesting as they are, but a summary of the final results and conclusions should be of value. It was found that after once loading to 50 per cent. of the nominal breaking load of the cable, further loadings showed no permanent set. The values of "E" were determined for straining cords to B.E.S.A. Specification 3 W.2 in all sizes from 25 cwt. up to 180 cwt., and as a result it was found that for 25 cwt. to 135 cwt. straining cords, the apparent value of "E," including end fittings ranged between 10,000 and 11,000 tons/sq. in. This value holds good up to 50 per cent. of the breaking load of the cable.

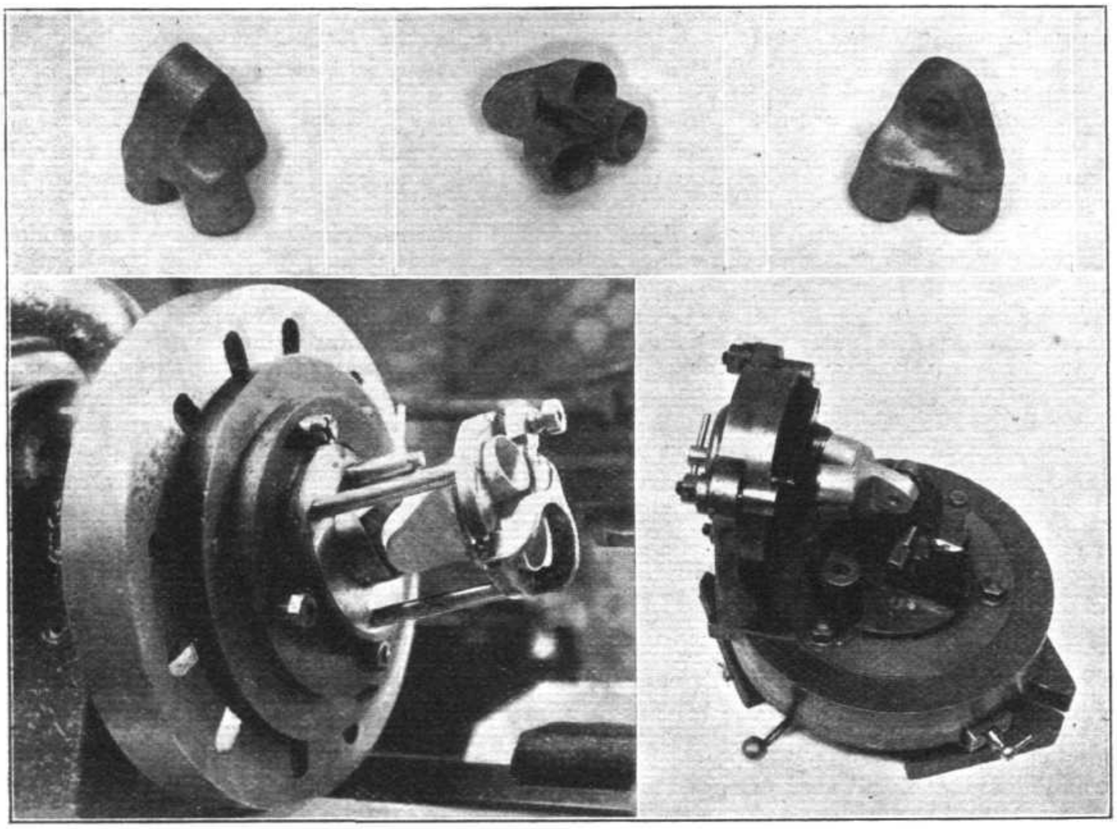
For straining cords larger than 135 cwt. it was found that the apparent value of "E," including end fittings, was only of the order of 8,000 tons/sq. in. It was noticed that this fall-off in the value of Young's Modulus occurred when the formation of the cord changed from the single rope comprised of a number of single strands to the rope formed of a number

24 tests, 11 failed by the breaking of the cable, 6 due to the shearing of the pins and the remainder by the failing of the fork ends. In every one of the above cases, the nominal breaking load of the cable was exceeded.

The operation of forming steel and Duralumin strip into closed-joint or bulbous sections is dealt with in the later pages of this article. What we are concerned with at present is—

The Boulton and Paul Continuous Heat Treatment Process

The Boulton and Paul plant includes four draw benches, each 70 ft. long. Each of these is equipped with a wire-wound electric muffle furnace fitted with automatic temperature control. Full lengths of the formed sections are fed through at a rate which depends upon the nature of the operation—whether hardening or tempering—the class of steel, the form of the section, the gauge of the strip from which the section was formed, and the mass of steel per foot run of section. The section passes through the furnace at the appropriate speed, is raised in temperature and soaked at least two minutes at the hardening or tempering temperature before emerging into the air. A short distance (a few inches) along the draw bench is a cast iron, water-cooled die, through



Figs. 14, 15 and 16. Oblique sockets for radial struts. Above, the casting bored, milled and drilled, and profiled. On left, casting in boring jig, On right, casting in milling and drilling jig.

which the section passes next. This die completes the cooling and maintains the shape. What really happens in the hardening operation is an air quench, and the section has cooled through its critical range before reaching the water-cooled die. An air hardening steel must therefore be used.

It is not surprising that difficulties were encountered in the early days due to the high hardening temperatures and the slow and variable response to heat treatment of the stainless steel used. However, by now the difficulties have been overcome, and several miles of strip have been successfully and uniformly heat treated. This has only been achieved by the closest attention to details such as a full knowledge of the composition and microstructure of the strip in the annealed state, a close control of temperatures, and a close control of rate of feed through the muffles.

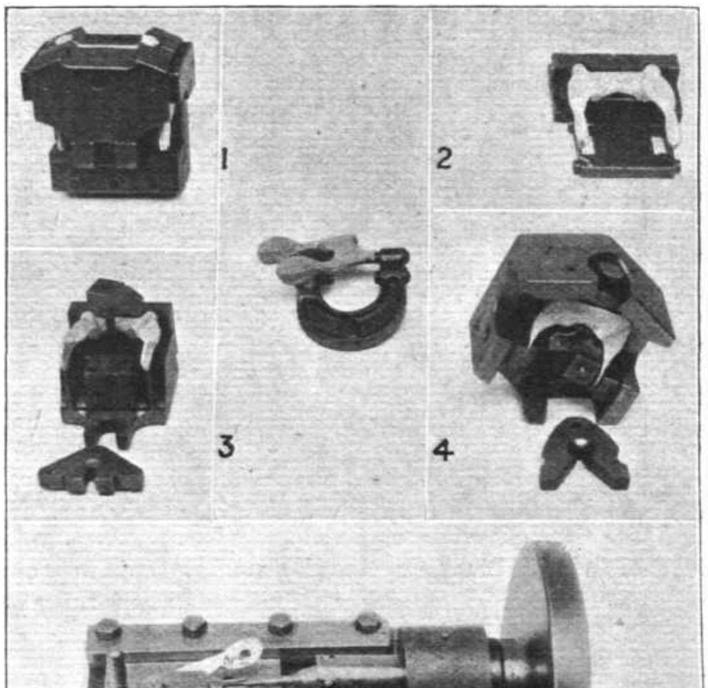
It is claimed that the uniformity of the product of the Boulton and Paul continuous heat-treatment process is much greater than was obtained from steel strip hardened and tempered in the coil. With coil-treated strip a variation of as much as 25 tons/sq. in. in the tensile strength along a length of 60 ft. was often encountered. As typical of modern results with sections formed from the soft strip and heat treated after forming, a 50-ft. closed-joint tube was taken at random from stock and cut up for test into short lengths. The size chosen was $1\frac{3}{4}$-in. O.D. $\times$ 20 g., *i.e.*, the most difficult from the heat treatment point of view. The test results showed a range on proof stress of 64·9 to 68·7 tons/sq. in.; on ultimate stress, a range of 88·3 to 93·0 tons/sq. in., and a range on transverse close bend of $2 \cdot 25 \times t$ to $3 \cdot 0 \times t$. In a difficult steel, such uniformity can only be described as remarkable.

Rockwell hardness tests and close bend tests are carried out on each end of every section after cutting to length, an allowance being made on length for test purposes. With the difficult steel used, direct correlation between the Rockwell machine and the testing machine is realised by furnishing the Rockwell machine with tensile test pieces which have been pulled for proof stress and ultimate stress. It is necessary to supply such test pieces representing every cast of steel used, every gauge of strip, and every annealing heat (by strip rollers). Special combinations of loading and penetrators of the Rockwell machine are necessary for dealing with very thin strip, *i.e.*, 26-30 g.

In the heat treatment of Duralumin for the R.101 structure, the annealing temperature is never used. When forming work has to be done, the material is quenched from its final heat treatment temperature (480° C. ± 10° C.) and the necessary work is done within the first two hours of the ageing period. Heat treatment is carried out in a molten salt bath under accurate temperature control from recording pyrometers.

The Forming of Special Sections

The manufacture of special sections from "thin" steel strip has been a speciality of Boulton & Paul, Ltd., for nearly 10 years, this firm being one of the pioneers of steel



Figs. 17 and 18. Operations on wiring shackles, which are steel stampings. Views 1, 2, 3, and 4 above show stamping in filing jig, in setting gauge with profile filed, in jig ready for milling, and in jig for drilling barrels. Below, stamping in hand tapping machine.

aircraft construction in Great Britain. During this period a vast amount of experience has been accumulated, and the benefit of this was naturally felt during the construction of the structure members of R.101. Reference has already been made to the fact that in the earlier days of steel construction, it was the custom to obtain the steel from the manufacturers in the form of strip which had already been

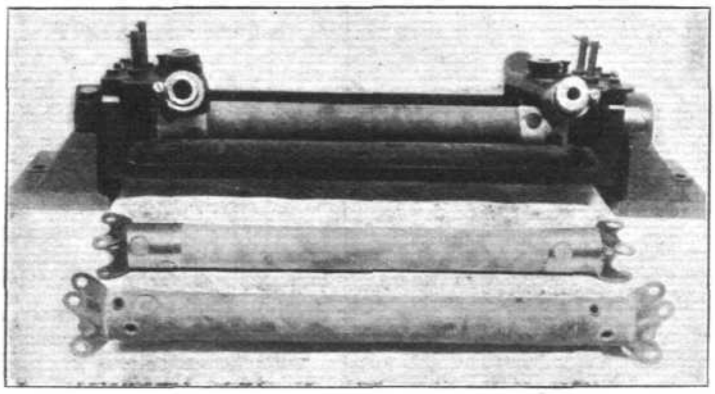


Fig. 19. Base struts for frame longitudinals. In jig, with fork ends loose, and with shear bushes in place.

hardened and tempered, the forming being done on the strip in that condition. Among the disadvantages of this method was the lack of uniformity and consequent inconsistency of "spring back," and also a cramping due to a lack of ductility, which limited the design of sections.

Realising this, from hard experience, Boulton & Paul set to work to evolve methods of working the soft strip, carrying out the heat treatment processes after the strip had been formed into the desired sections. Their efforts were attended by such success that it has now become possible to place the manufacture of special sections in stainless steel on a sound mass-production basis, and the following notes give an outline of the procedure. Put quite briefly, the Boulton & Paul process consists in forming the sections from soft strip, carrying out the hardening and tempering by a continuous process which results in the material of the section being particularly uniform as regards mechanical properties, and also in the section being of uniform dimensions within very small limits.

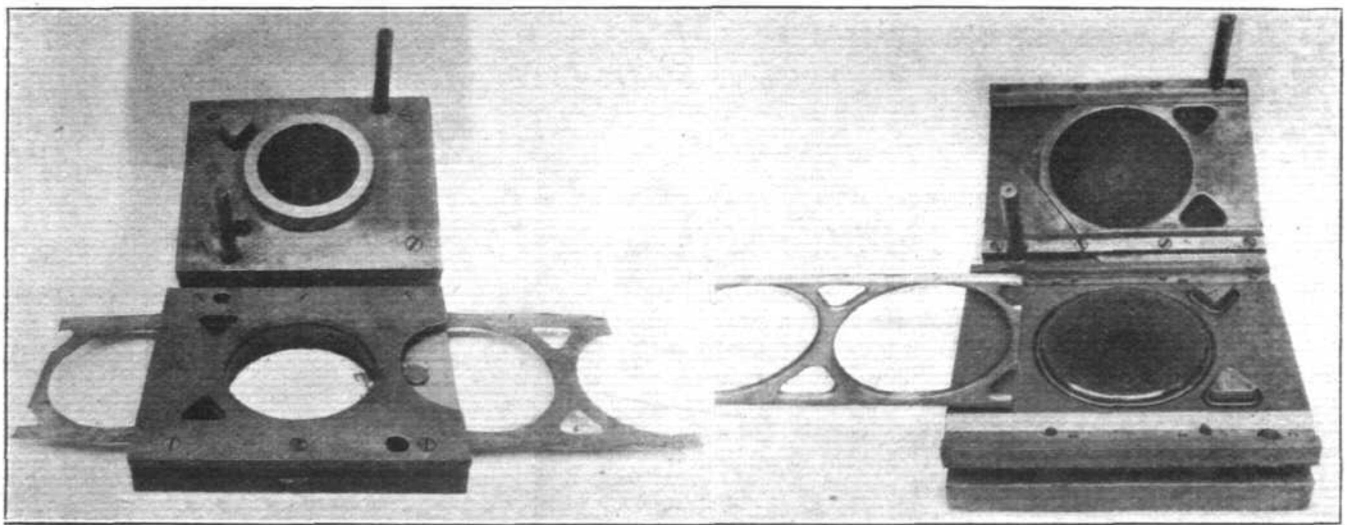
Special problems arose in connection with the girders for R.101, partly due to the use of stainless steel, and partly to the long lengths of girder required (some 47 ft.) in $1\frac{3}{4}$-in. O.D. tubing. The conclusion was formed that the only method by which such sections could be produced with the necessary uniformity was to form the sections completely in the softest state in which the material could be obtained, and then harden and temper after forming. The fact that quantities like 30,000 ft. of $1\frac{3}{4}$-in. O.D. closed-joint tubing and 30,000 ft. of booms for ridge girders have now been produced proves rather conclusively that the method evolved by Boulton & Paul is a practical one for mass-production working.

The plant used for the manufacture of the airship girders comprises four drawbenches, each 70 ft. long (see Figs. 4 and 5), two rolling machines, one strip cutter, and one section cutter. The drawbenches were designed by the Boulton & Paul staff, and made up in the B. & P. works. The drive of the drawbenches is through friction discs, so that a variable speed of pull is obtainable. The speed is also capable of being changed very gradually.

The dies are held in special holders fitted to the drawbench channels, and are definitely locked in place by a downward-moving head operated by a hand wheel. The control of the speed is carried out from the die head end of the bench by means of a push rod, so that the operator setting the dies can readily control the speed of the chain. An electric furnace is fitted to each drawbench at the die holder end, and a speed indicator is fitted to show the speed of drawing, which is very important when the section is being hardened or tempered.

In the case of the closed-joint tubing, the corrugations which later form the closed joint are formed along the edges of the strip by drawing the strip through dies. Then the strip as a whole is curved to a circular section by passing through other dies. The final seaming is done by pulling the section through a circular die and over a mandril so shaped as to fold the corrugated edges over one another. It is even possible, and quite frequently done, to form a liner inside the main tube where a short length only has to withstand a greater load than the main tube. The whole process of forming the closed-joint tubing is done in one pass, the flat soft strip entering the drawbench at one and, and the finished tubing (as regards forming) emerging at the other.

Hardening.—Having formed the section as described above, the section is passed through the electric furnace for hardening. This is carried out as follows: A die is set up on the entry side of the furnace, its diameter of bore being such that some, but not too much, friction is offered to the passage of the tube section. The furnace is heated to the required temperature (about 1,050° C. for stainless steel) and a water-cooled die fitted up in the die holder of the drawbench. This water-cooled die is a hollow cast-iron die through which cold water is continually flowing. The tube section is then pulled slowly through the furnace, the first die maintaining just sufficient tension on the section while it is in the furnace to ensure straightness of the finished product. The hot section then



Figs. 20 and 21. Presses for stamping out Duralumin webs of ridge girders. On left, the press used for stamping out lightening holes, and on right, the tool used for flanging the holes.

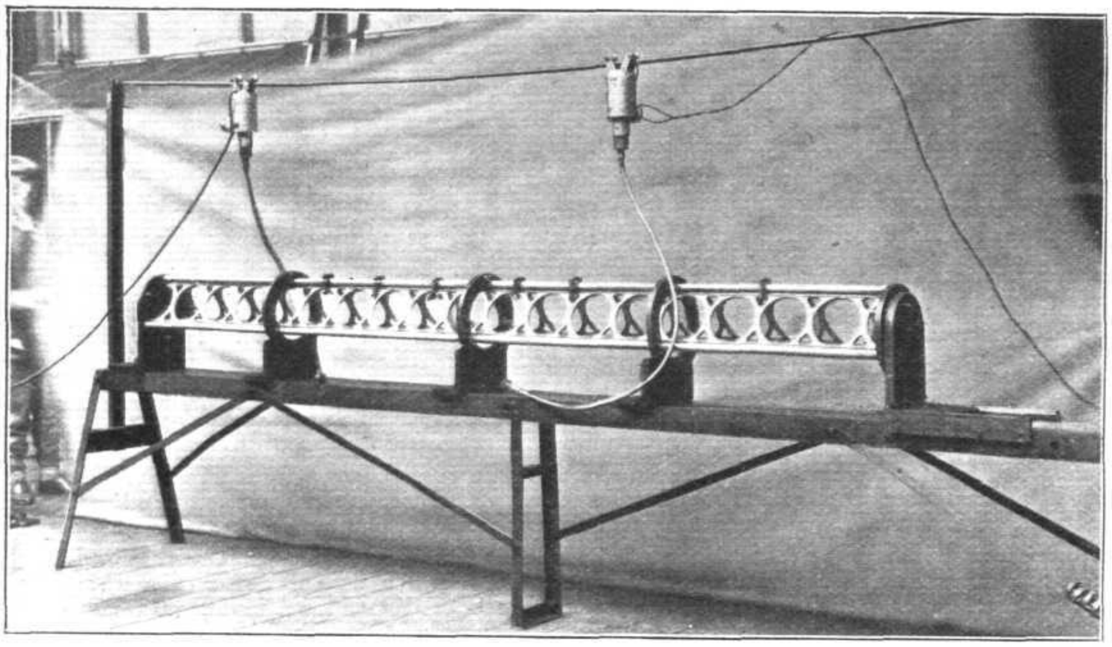


Fig. 22. A ridge girder assembly jig.

enters the water-cooled die, which completes the quenching and hardening of the section.

Tempering.—The tempering operation is very similar to the hardening process, with the exception that the temperatures are, of course, different, being in the neighbourhood of 420°-450° C. for stainless steel.

Cutting to Length.—The cutting of the hardened and tempered sections is carried out by means of a mild steel disc of 16 g. running at high speed.

Certain sections are formed not by drawing but by rolling, passing the strip through a series of rolls which gradually produce the required shape. An example of section formed by rolling is the bulbous section boom used in the ridge girders. The actual rolls which form the section are mounted on horizontal spindles, and these are followed by one pair of rolls on vertical spindles, which close in the section. In order to preserve the shape, an insert is carried between these rolls, so that the strip is located between the rolls and insert.

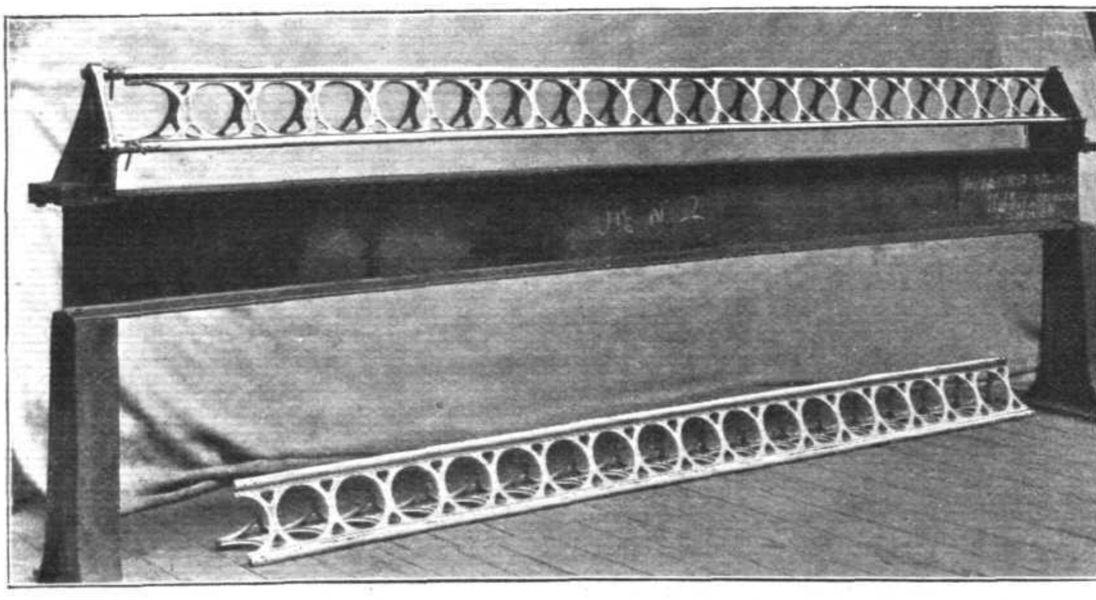
Forming Duralumin Sections.—Duralumin strip is formed by exactly similar methods into sections, either by drawing or rolling, but no furnace heat-treatment is necessary. The Duralumin sheet is first cut to the required width on the strip-cutting machine and then the coils are given the final heat-treatment in the salt bath. After washing, the coils are dipped in a bath of beeswax and tallow for a time, and then taken either to the drawbench or to the rolling machine. Among the Duralumin sections formed by drawing may be mentioned the closed-joint tubes used as struts in the main longitudinals, and sections of Duralumin formed by rolling are the bulbous booms of the radial struts.

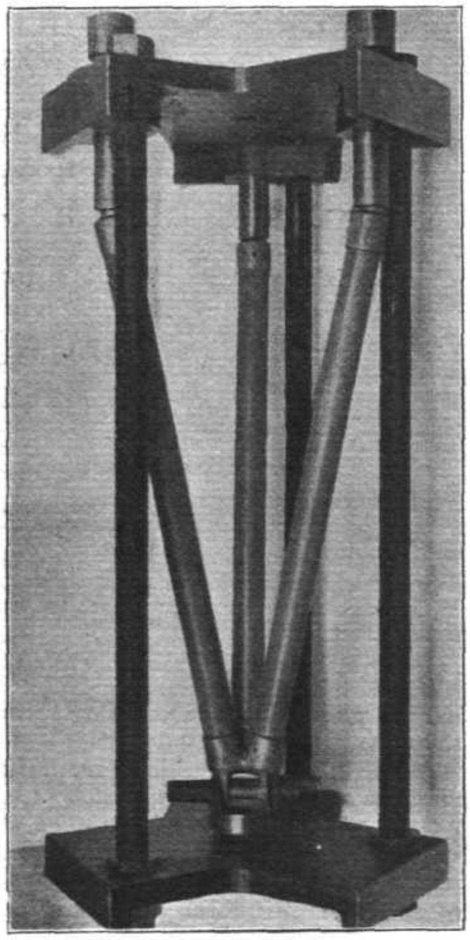
The Use of Special Jigs

Having now outlined the process of manufacturing tubes and booms from flat strip, the next stage will deal with some of the problems encountered in milling and drilling some of the smaller parts, in which great accuracy was essential, and in assembling the tubes and booms, &c., into girder units of considerable length (up to 47 ft.) with such accuracy that the transverse "rings," frame longitudinals and main longitudinals could be erected and assembled at Cardington without any fitting being done during the erecting process.

There are so many small parts in a huge structure like the R.101 that it is somewhat difficult to decide where to begin, each part, however small, being an important item in the finished structure. The stampings which connect the transverse "rings" or frames to the longitudinals, and known as the outer ridge main joint stampings, are typical of the sort of work involved, and will form a good subject for illustrating the problems with which the works manager, Major Noble, had to contend. The extensive use of jigs was the only solution, and of these a large number had to be designed and produced before the actual work could be begun. In the case of *the outer ridge main joint stampings*, the jigs had to be made to reproduce geometrical conditions of rotation around two principal axes, and to deal with patterns generally similar, but with dimensions varying over a wide angular range. It was also necessary to hold the work in such a way as to minimise distortion due to the removal of large quantities of metal. Details of jigs and sequence of operations are shown in the photographs, Figs. 6, 7, 8 and 9. The sequence of operations is as follows: Mark off with centre

Fig. 23. A ridge girder fork-ending jig.

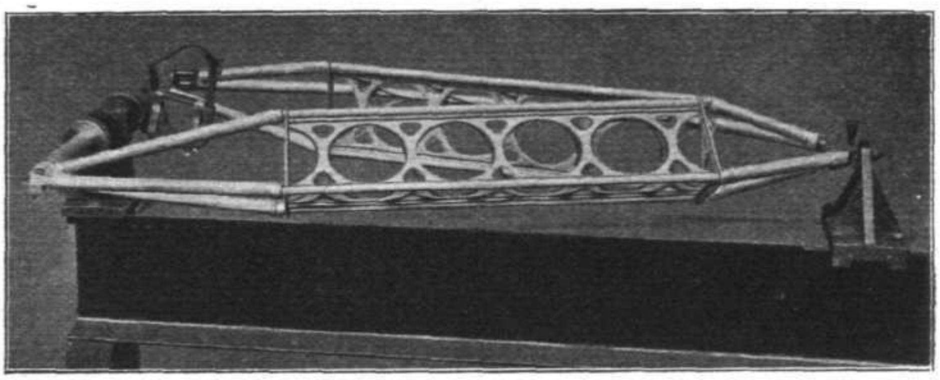




Figs. 24 and 25. On left, assembly jig for pyramid ends of radial struts. Below, assembly jig for double radial struts.

radial struts, no bolt holes were available for location purposes in the jig, and the method adopted was to spot face both sides of the stamping, and to have an extra piece stamped on to carry a locating hole over a pin on the jig. The remainder of the location was carried out by using a slot into which one lug of the stamping fitted. The sequence of operations was as follows: Spot mill both sides and face locating stamping; mark off as centre line; drill and ream for locating peg; mill end lug for location; mill side lugs; rough mill top jaws; finish milling top jaws; drill jaws, and drill for centre bolt; finish mill centre bolt bosses, and lighten.

Oblique Sockets for Radial Struts.—The radial struts connect inner and outer ridge girders of the transverse "rings" or frames, and the sockets for them are in the form of aluminium die castings. They have to be milled and drilled to take up a series of angles; there are two principal axes and the different parts are obtained by rotations around these axes. Photographs illustrating these sockets and the jigs used will be found in Figs. 14, 15 and 16. The sequence of operations



line; spot face, then mill, drill and ream the lugs at vertices of triangle. These lugs are then used as location points for all subsequent work; rough mill angular lugs; lighten (a special fixture is used for this, allowing quick clamping in any position, and accurate angle set in three dimensions); finish milling angular lugs, and drill these lugs in a milling

is: Boring tube sockets; milling and drilling of lug; and profiling of lug.

Wiring Shackles.—Very large numbers of these are used, notably in the wire bracing of the main and frame longitudinals. They are in the form of steel stampings, and it is necessary to machine them so that the plane of the axis of the

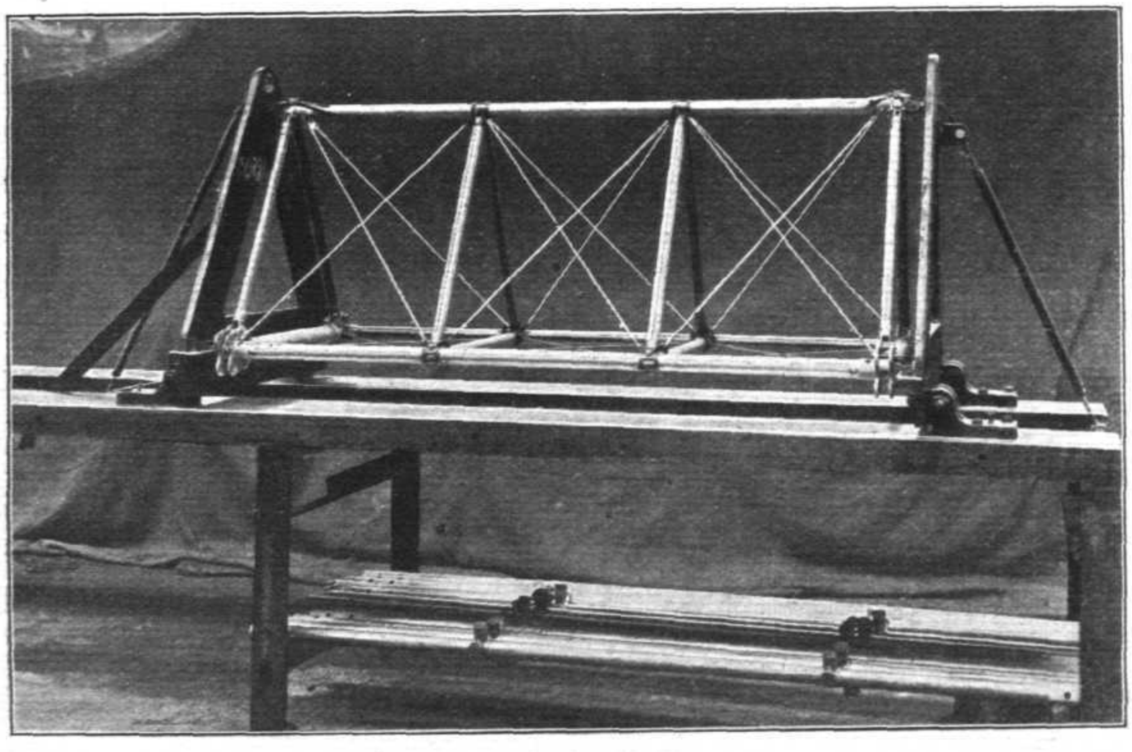


Fig. 26. Assembly jig for frame longitudinals.

machine through the special fixture provided. Owing to the importance of the accurate production of these stampings, each has its appropriate part number stamped on it while in the jig, and this stamp is checked by an inspector against the jig setting.

In the case of *the inner ridge main joint stampings* (see Figs. 10, 11, 12 and 13), which connect inner ring joints with

threaded holes and the intersection of these axes lies on the axis of the shackle end. Various jigs used are shown in Figs. 17 and 18. The sequence of operations is: Set stamping and file profile to template (see Fig. 17 (1)). The stampings subsequently locate from this; mill shackle end. This is a case where it has been found that the best method is to mill with vertical feed; drill in drilling jig; and tap in hand

tapping machine (Fig. 18). The threads have to be kept strictly to B.E.S.A. tolerances, and it has been found that these cannot be maintained with machine tapping.

Base Struts.—These occur at each end of the frame longitudinals, in the base of the triangle, and also form the third side of the triangle of which the other two sides are formed by the main radial struts. In other words, the base struts form the common base of the frame longitudinal triangle and the radial struts triangle. They can be seen in the photograph of the assembly jig for frame longitudinals (Fig. 26). and in more detail in Fig. 19, which shows one of the struts with fork ends loosely in place, in the jig, and finished with shear bushes in place. The method adopted in producing these struts is to finish the fork ends and then hold the tube with the fork ends in a special jig, drilling and reaming for shear bushes in this jig.

Duralumin Girder Webs.—These are used extensively in the girders of the transverse frames, *i.e.*, inner and outer ridge girders and radial struts, of which they form the webs while the flanges are formed by bulbous booms in either steel or Duralumin according to location in the framework. The webs are produced by pressing from Duralumin strip, the first operation being to punch the lightening holes. The press tool used for this operation is shown in Fig. 20. The punched strip is then treated in the salt bath, and the strip passes on to the next press in which the lightening holes and sides are flanged-up. The tool is shown in Fig. 21.

Fig. 27. General view of main longitudinal in jig. Other longitudinals ready for trueing.

Assembling

The finishing of what may be termed " small parts " having been completed, the assembly into girder units begins.

Ridge Girders.—These consist of Duralumin flanged webs and bulbous booms. The webs and booms are cut to exact length and are then assembled and put in a jig (Fig. 22) which has standard plug ends to suit the triangular form of the girder. The drilling and partial riveting is done in this jig, and the girders are then removed and final riveting completed on the bench by pneumatic hammers.

The girders are then passed on to the ridge girder fork-ending jig (Fig. 23), which carries fork ends arranged at the correct triangular spacing. One end frame is fixed, and the other is adjustable, but is dowelled in place for each length of ridge girder required. The longitudinal spacings are obtained by the use of standard end rods. The fork ends are assembled in the girder, and the assembly is first placed in the jig and one taper pin put through each fork end. The girder is then removed from the jig, and the final taper pinning done on the bench. It is, of course, finally inspected with the jig set to the required length.

Double Radial Struts.—The pyramid ends for these struts are prepared before the general assembly in order that the tubes for each jig should butt joint in the various end sockets. To enable this to be done in the easiest manner, special adjustable end gauges are used, and the length of each tube is determined by these. The purpose of the jig used for this operation (Fig. 24), is to control the size and angles of the pyramid.

The final assembly of the double radial struts is carried out with a jig (Fig. 25) arranged to reproduce the geometrical conditions that have to be satisfied. The required angle is obtained by means of the clinometer bar and clinometer shown in Fig. 25. As in the case of other jigs, the sliding head is dowelled for each length, and the setting positions are determined from standard end bars.

The Longitudinals.—The final erection of the frame and main longitudinals is carried out between jig plates mounted on steel benches. The fittings on the end of the jig plates are set out to the standard triangular section of the longitudinals, and the distances between these plates are determined by rod end measurements. The inclination of the end plates to the vertical is determined by careful plumb line measurements. The booms forming the longitudinals are cut to length, and have the fork ends inserted in jigs specially made for this purpose. The method adopted in all cases for drilling these longitudinals was that of finishing the fork ends, then holding the fork ends and booms in correct position in the jigs, and drilling through the fork end and tube while in the jig. The whole of the longitudinals are cambered, and the cambers are set in the final assembly jigs by tensioning the bracing wires and taking measurements from the bench at different points. A frame longitudinal is seen in its assembly jig in Fig. 26, and a main longitudinal in Fig. 27.

Special Main Longitudinals.—Between frames 12 and 13 the longitudinal system of the airship changes from 15 to 16 sides. The problem of constructing this particular set of longitudinals from frame 12 to frame 13 naturally became somewhat complicated. The method adopted was to use the frame longitudinals for each ring set in their relative

positions, and to build the main longitudinals between these. As the front faces of frame 12 and rear faces of frame 13 are of standard type, it only became necessary to regard one longitudinal of frame 13 as fixed in position at its rear end, and to displace the corresponding longitudinal in frame 12 by a calculated amount. The frame longitudinals for frames 12 and 13 were assembled on jigs (Fig. 28) in which the fittings carrying the fork ends were adjustable vertically and also around a vertical axis.

Cables and Cable Ends.—Reference has been made in an earlier section of this paper to the special form of cable end fittings employed in R.101. These end fittings, which are used in several sizes and with arrangements for straining the cables and taking up slack, all have this in common, that they have one end formed with an internal cone (see Fig. 29) which receives the end of the stranded cable. In making up the cables with end fittings a clamp is fitted tightly around the cable, some 2 in. from where it is to be cut. After being cut off, the ends are splayed out and the cone ends slipped over, the strands being held tightly together while this is being done. The splayed-out end is

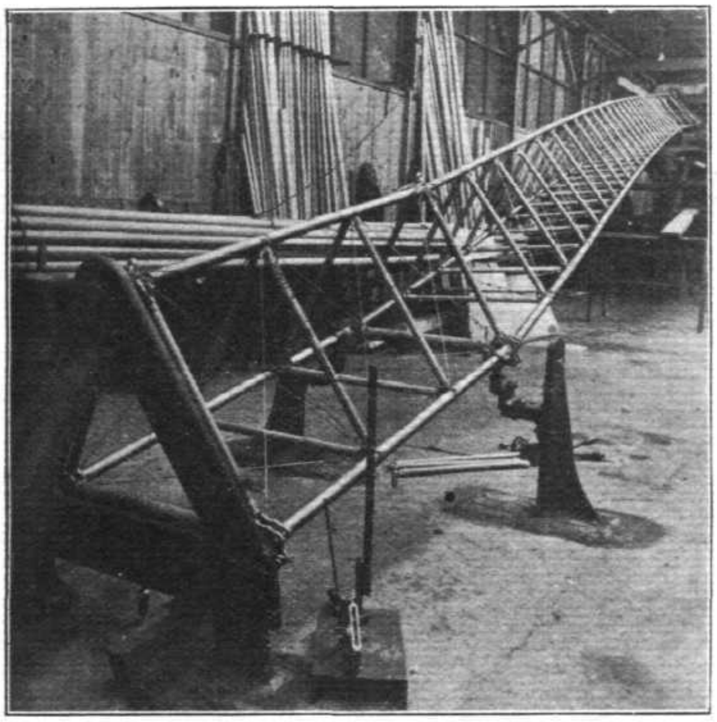


Fig. 28. Special main longitudinal. Between frames 12 and 13 the longitudinal system changes from 15 to 16 members.

then "cazined" into the fitting, thus forming a solid conical end which, as the actual end fitting forms the mould, is a good fit for taper in the conical seating. The end of the "cazined" portion is then cut square, and the fork end fitted to the cone portion.

The complete cables are loaded through their fork ends up to 50 per cent. of the breaking load of the cable. This is done to bed the end cone into the fitting and generally stretch the cable to prevent the permanent set occurring when the cable is used.

The machine used is a long bench, at one end of which is a winch and at the other a calibrated lever. The cable is attached by its end fittings to the winch and the lever arm, and load is applied until the lever arm lifts, the arm being weighted to correspond to the load required. For the smaller cables the lever arm is replaced by a spring balance so that the load applied can be directly measured.

PROTECTION AGAINST CORROSION.

Two processes are made use of in protecting the structural materials of R.101 against corrosion—the anodic oxidation for the protection of the surface of aluminium and its alloys by the formation of an adherent film of oxide on the surface, and a form of closely-controlled Sherardising for protecting steel parts against rust.

Anodic Treatment.—The anti-corrosion treatment of aluminium and aluminium alloys known as the anodic treatment is a Government patent, and consequently one cannot give particulars of it here. Boulton and Paul probably own the largest plant in this country operated under the Government patents, and have probably treated a greater number of square feet of surface than has any other firm. The very closest control is necessary if the treatment is to be really effective, and it is interesting to find that even after their extensive experience Boulton and Paul find that they cannot relax in any degree the closeness of the necessary control exercised.

Of the materials used in R. 101, two only are aluminium alloys: The aluminium-silicon alloy die castings, and Duralumin used in the form of sections, closed-joint tubes, solid-drawn tubes, stampings, rivets, and parts machined from bar. The aluminium-silicon alloy as die cast has such excellent resistance to corrosion that the Anodic Treatment is unnecessary and would be no improvement; accordingly it has been dispensed with for the die castings, and is only used for the Duralumin parts. From tiny rivets to solid-drawn tubes $2\frac{3}{4}$-in. O.D. and 30 ft. long, all Duralumin parts have been given a film of oxide and a coating of Lanoline.

The Anodic Treatment process requires the closest control of (1), Loading of the plant for current density. This varies with the composition of the alloy and with the state of the

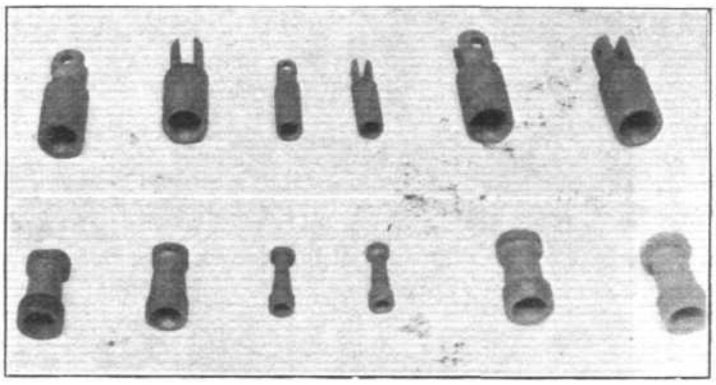


Fig. 29. Conical cable ends are used, the cable strands being splayed out and soldered with "Cazin."

surface, *i.e.*, whether machined, as stamped and pickled, rolled, &c. (2) Rate of voltage rise. (3) The duration of the "soak" at the film-forming voltage of 40. (4) Concentration of the electrolyte (chromic acid) in the bath.

The Anodic process has another advantage, in that it assists considerably in revealing flaws in Duralumin parts. By exercising selective attack on faulty places, it reveals at once localities of flaw, segregation, etc., which were entirely masked to ordinary inspection.

Rustproofing.—The rustproofing process used by Boulton & Paul for steel members may best be described as a form of Sherardising, in which is maintained the closest control of: (1) the density of loading of work into the drums; (2) the composition, within close limits, of the zinc-zinc oxide dust mixture; (3) the rate of increase of temperature; and (4) the maximum temperature and the time of soak at maximum temperature.

It has been found possible to control the thickness of coating within very close limits, so that it is safe to count upon an increase in dimensions due to the addition of a coating, the thickness of which always lies between 0·0003 in. and 0·0006 in. As a result of their long experience, Boulton & Paul are confident that this rustproofing is superior in every way to electro-deposition of zinc. The coat is well alloyed to the steel, and is non-porous to all the tests that it has been possible to devise, *e.g.*, the ferroxyl test modified to suit the special requirements.

The process, with proper close control, is claimed to be an eminently satisfactory one, and among the many thousands of steel stampings, tubes, etc., which have been treated during the manufacture of the structure of R.101, the rejected parts sent back for re-treatment have not totalled a hundred.

PRIVATE  FLYING

A Section of FLIGHT in the Interests of the Private Owner, Owner-Pilot, and Club Member

THE GUEST SCHEME AND THE FLYING CLUBS

THE civil aviation scheme in which it has been suggested that the future of the flying clubs may be involved, brought to light in a recent issue of FLIGHT, is emerging from its obscurity in many directions and revealing an interesting existence.

This commercial company, formed to carry out the Guest scheme on an ambitious scale embracing nearly all aspects of civil aviation within the country, is called National Flying Services (Limited).

Government financial assistance where the club movement is involved has, apparently, already been promised in the following manner. For every pilot trained under the company's direction, the Air Ministry will pay £10, up to a total of £15,000 for the first three years. For the following seven years a sum of £7,000 will be the limit granted.

The company's programme, which is put forward as a possible assistance to clubs and not as opposed to them, includes the establishment of about 20 aerodromes and 100 emergency landing fields with the co-operation of municipalities, and the right to use its aircraft for general commercial purposes will be possessed. The first aerodrome will be at Feltham, Middlesex. Sir Sefton Brancker, Director of Civil Aviation, was enlightening on the issue during a recent address to the Scottish Flying Club at Renfrew, Glasgow. Congratulating the club on its progress, he remarked that although it was, with one exception, the youngest in the country, it was certainly the strongest from a purely commercial point of view.

But he reminded them that there were only two years to run under the present (subsidy) contract and the Treasury could only be persuaded, with the greatest difficulty, to agree to that contract (which applied to 12 or 13 clubs), and also insisted that when it finished nothing more would be done by the Treasury.

On top of that, continued Sir Sefton had come the Guest scheme on different lines. The older clubs felt that it was wrong of the Air Ministry to support it, but they had a ruthless Treasury which absolutely refused to go on supporting the clubs on their present basis. The whole object of the scheme was the centralisation of technical control.

Sir Sefton then reminded the club, in conclusion, that in two years' time they would be able to go on with that new organisation or, if they preferred, run independently. With regard to assistance, the only suggestion that he would make was that they must give the Scottish Club, if it decided for independence, as much help as the other scheme.

On November 23, there was an informal discussion at the Air Ministry in which representatives of the flying clubs took a critical part. It is understood that the opposing clubs have addressed their protests to Sir Samuel Hoare, Minister for Air.

Subsidy System in Detail

Two systems of subsidising the flying club movement since its inauguration have been evolved. The second one is the current system, and it came into force on August 1 last year, with a limited life of three years from that date. Its conditions benefit the clubs as follows: £50 is paid to each of the approved clubs for each pilot qualifying for the "A" or "B" licences.

Further, £10 is paid to each club for each active member who holds a current certificate, and a grant of 30*s*. per hour flying time up to a maximum of 20 hours per year for the flying done by each individual pilot. This enables a pilot member to earn the sum of £40 for his club.

No club can earn, or rather, receive, a total subsidy in any one year of more than £2,000. These conditions are more favourable to the recipients than those granted under the original system which gave each approved club a grant of £2,000 on its formation and a further grant of £500 per year for the first two years, plus £10 for each member who obtained his certificate.

With the present system, one finds that the Air Ministry is liable to pay out to the movement in its entirety a total subsidy of £16,000 per year, as every club does not qualify for its maximum subsidy of £2,000. There are 13 clubs favoured by official assistance.

According to the figures quoted for the Guest Scheme the Air Ministry will only be liable for an average sum of £5,000 per year for the first three years, and then only an average of £1,000 per year for the following seven years.

Thus the burden on the Air Ministry will be first a little below one-third per year of what it is now and subsequently only about one-sixteenth per year.

If the commercial company earned the £15,000 during the first three years, then that would mean 1,500 pilots being produced for the period, apart, of course, from any that might not be trained under subsidy conditions.

New clubs formed today do not receive assistance from the Air Ministry, that is, financially. When Sir Sefton Brancker opened the new Northampton Club in September, he broke the understood information to the committee promptly, explaining that all the money granted for the purpose of subsidising clubs had been already allotted for the next two years.

HOUSEHOLD BRIGADE FLYING CLUB

THE new Household Brigade Flying Club has a membership of 70 now and all are either past or present officers of the Household Cavalry and the Brigade of Guards. At present the Club will make arrangements with other clubs for flying instruction. Until March 30, the headquarters are at Brooklands, but from April onwards Heston Aerodrome, Middlesex, will be the flying quarters. This aerodrome is being established by Airwork, Ltd., and will first be 600 yards by 450 yards, and probably extended later to 800 yards by 800 yards. It was described and illustrated in FLIGHT, October 25, 1928.

The Club hopes to obtain a machine when at Heston for "A" licence pilots. Eight members have already their "A" licence and several others are under instruction. The President of the Club is Major-General C. E. Corkran, C.B., C.M.G., (Grenadier Guards), who commands the London District, Col. C. P. Heywood, C.M.G., D.S.O. (Coldstream Guards) is Chairman, and Lt. R. L. Preston (Coldstream Guards), Secretary and Treasurer. On the committee is Mr. A. S. Butler, Chairman of the De Havilland Aircraft Co., Ltd., who formerly belonged to the Coldstream Guards.

He is a private-owner pilot of considerable experience Others on the Club's committee are Capt. A. de L. Cazenove (Coldstream Guards), Capt. A. Tennyson d'Eyncourt (Coldstream Guards), Lieut. H. W. D. Packenham (Grenadier Guards), Lieut. A. V. C. Douglas (Scots Guards), Lieut. E. L. Donner (Irish Guards) and Capt. A. T. Rhodes, M.V.O. (late Grenadier Guards).

Among the members is Mr. St. J. Plevins (late Welsh Guards) now of the Anglo-American Oil Co., Ltd.

The secretary, Lieut. R. L. Preston, used to own a B.E.2e. G-EANW, and was one of the Gordon-Bennett Balloon Cup team that went to Antwerp. He entered a Blackburn "Bluebird" light aeroplane in the King's Cup Race this year and flew in it as passenger. The pilot was Flying-Officer L. S. Birt and they retired outside Birmingham. Lieut. Preston is also an Associate Fellow of the Royal Aeronautical Society, and founded, with Mr. David Kittel, the private-owner pilot, the Private Owners Club.

At Brooklands Aerodrome, on November 9, the Club held its first air meeting.

LIGHT 'PLANE CLUBS

London Aeroplane Club, Stag Lane, Edgware. Sec., H. E. Perrin, 3, Clifford Street, London, W.1.
Bristol and Wessex Aeroplane Club, Filton, Gloucester. Secretary, Major G. S. Cooper, Filton Aerodrome, Patchway.
Cinque Ports Flying Club, Lympne, Hythe. Hon. Secretary, R. Dallas Brett, 114, High Street, Hythe, Kent.
Hampshire Aero Club, Hamble, Southampton. Secretary, H. J. Harrington, Hamble, Southampton.
Lancashire Aero Club, Wodford, Lancs. Secretary, F. W. Atherton, Woodford Aerodrome, Cheshire.
Liverpool and District Aero Club, Hooton, Cheshire. Hon. Secretary, Capt. Ellis, Hooton Aerodrome.
Midland Aero Club, Castle Bromwich, Birmingham. Secretary, Major Gilbert Dennison, 22, Villa Road, Handsworth, Birmingham.
Newcastle-on-Tyne Aero Club, Cramlington, Northumberland. Secretary, J. T. Dodds, Cramlington Aerodrome, Northumberland.
Norfolk and Norwich Aero Club, Mousehold, Norwich. Secretary, G. McEwen, The Aerodrome, Mousehold, Norwich.
Nottingham Aero Club, Hucknall, Nottingham. Hon. Secretary, Cecil R. Sands, A.C.A., Imperial Buildings, Victoria St., Nottingham.
The Scottish Flying Club, 101, St. Vincent Street, Glasgow. Secretary, Harry W. Smith.
Southern Aero Club, Shoreham, Sussex. Secretary, C. A. Boucher, Shoreham Aerodrome, Sussex.
Suffolk Aeroplane Club, Ipswich. Secretary, Maj. P. L. Holmes, The Aerodrome, Hadleigh, Suffolk.
Yorkshire Aeroplane Club, Sherburn-in-Elmet, Yorks. Secretary, Lieut.-Col. Walker, The Aerodrome, Sherburn-in-Elmet.

LONDON AEROPLANE CLUB

Report for week ending November 25.—Pilot instructors: V. H. Baker, F. R. Matthews. Ground engineer: C. Humphreys. Aircraft: The following machines were in commission during the week—G-EBNY, G-EBXS. Total flying time for the week: 9 hrs. 5 mins. Dual instruction: 11 members were given dual instruction during the week, the flying time being 4 hrs. 40 mins. Solo flying: 11 members made solo flights during the week, the time being 4 hrs. 25 mins.

W. W. Briscoe made his first solo flight on the 20th instant.

A. C. Thomas completed the tests for his Aviator's certificate.

Last week proved to be the worst week, as far as flying was concerned, since the club, started due to the unfavourable weather conditions. Flying was only possible on one day, viz., Tuesday, when we were able to get in just over 9 hrs. flying. The staff were kept very busy preventing the sheds and machines being blown away.

D. H. Moth Cirrus Mark I G-EBNY has been disposed of to Mr. A. E. Burns, and it will be replaced by a D.H. Moth Cirrus Mark II at the earliest possible moment.

Christmas Raffle.—Tickets for the Christmas raffle of a D.H. Moth Cirrus Mark I are going very well, and members who have not already done so are requested to make early application.

CINQUE PORTS FLYING CLUB

Report for week ending November 24.—Pilot instructor: Maj. H. G. Travers, D.S.C. Ground engineer: Mr. R. H. Wynne. Machines: 2 (NN and YJ). Total flying time: 4 hrs. 40 mins. Dual instruction: Mr. Evernden, 15 mins.; Mr. Wanliss, 1 hr.; Mr. Clemetson, 1 hr.; Mr. Worsell, 45 mins.; Mr. Harrison, 15 mins. Total (five members): 3 hrs. 15 mins. Soloists under instruction: Mr. Martin, 1 hr.; Mr. Worsell, 15 mins. Total (two members): 1 hr. 15 mins. Test flight: 10 mins.

Another succession of gales stopped flying on all except two days this week.

There has been an immediate response from the officers at the Small Arms School, Hythe, to our reduced terms recently announced. Three officers, Messrs. Wanliss, Harrison and Hamilton, have joined the club during the week, and the two first named have already started flying, Mr. Wanliss proving a very apt pupil.

Mr. E. T. Worsell, of Offham, West Malling, was launched solo on Sunday, November 18. His first landing was not very good, but he very sensibly switched on and went round again, and his second approach and landingwere far better. The club congratulates Mr. Worsell on his performance, as he has been trying hard for a considerable time under the severe handicap of having little time at his disposal and a great distance to come for his flying. We hope that he will go right ahead and take his "A" licence.

HAMPSHIRE AEROPLANE CLUB

Report for week ending November 24.—Pilot instructors: Flight-Lieut. Swoffer, M.B.E., and Mr. W. H. Dudley. Ground engineers: Mr. E. Lenny and Mr. J. Elliott. Aircraft: D.H.60 Moths, G-EBOI and G-EBOH. Flying time for the week, 14 hrs. 15 mins. Pupils under instruction, (14), 8 hrs. 10 mins. Soloists, (2), 1 hr. 50 mins. "A" pilots, (6), 3 hrs. 20 mins. Passengers, (2), 25 mins. Tests, (6), 30 mins.

The continuous bad weather has greatly interfered with our flying this week. Machines have only been able to leave the hangar on two days. However, Lieut. Oswald was able to complete the tests for his "A" licence.

LIVERPOOL & DISTRICT AERO CLUB

Report for week ending November 24.—Machines in commission: Avro Avians WK and XY. Instructor: Mr. J. B. Allen. Ground engineer: Mr. H. Pixton. Total flying time, 13 hrs. 20 mins. Seventeen pupils flew 8 hrs. 40 mins. dual, and two 1 hr. 30 mins. solo. Six "A" pilots totalled 2 hrs. 45 mins. One passenger, 15 mins. Five test flights total 25 mins.

Mr. Pixton has been leading a life of leisure, all machines being O.K. and the gale having prevented flying for the last three days.

Nature Note.—Our blue tit has gone. Mr. Pixton repaired the hole in the XX's wing and we must regretfully conclude:—

Blue tit got "lit" on dope no hope.
In wing, poor thing—wing repaired—*finis* bird!

MIDLAND AERO CLUB

Report for week ending November 24.—The total flying time was 16 hrs. 33 mins. Dual, 4 hrs. 5 mins. Solo, 9 hrs. 40 mins. Passenger, 2 hrs. 10 mins. Test, 38 mins.

The following members were given dual instruction by Flight-Lieut. T. Rose and Mr. W. H. Sutcliffe: M. C. Wilks, T. W. Wild, G. C. Jones, M. Turner, H. Coleman, C. W. R. Gleeson, C. T. Davis, H. Shaw, W. Evershed, Mrs. Leigh Fermor.

"A" pilots.—E. P. Lane, G. C. Jones, S. G. Hall, E. R. King, E. L. Jackson, J. Rowley, R. C. Baxter, M. A. Murtagh, S. H. Smith, R. D. Bednell, H. J. Willis, G. Robson, W. Evershed, S. Duckitt.

Soloists: W. L. Handley, M. C. Wilks, R. G. Welch, H. E. Evans, H. Coleman, J. W. Astley, J. K. Morton.

Passengers: B. Scribbans, M. Turner, H. Harrison, A. Harley, Mrs. Harley, G. C. Jones.

Mr. J. K. Morton passed the flying tests for his "A" licence.

NEWCASTLE-UPON-TYNE AERO CLUB

Report for week ending November 25.—Pilot instructor: G. M. S. Kemp. Ground engineer: K. C. Brown; Assistant, J. Tait. Machines: Three until 4 p.m. Friday, 23rd inst., PT, QV, LX. Flying time for week, 1 hr. 10 mins. Instruction, 1 hr. 10 mins; 2 pupils.

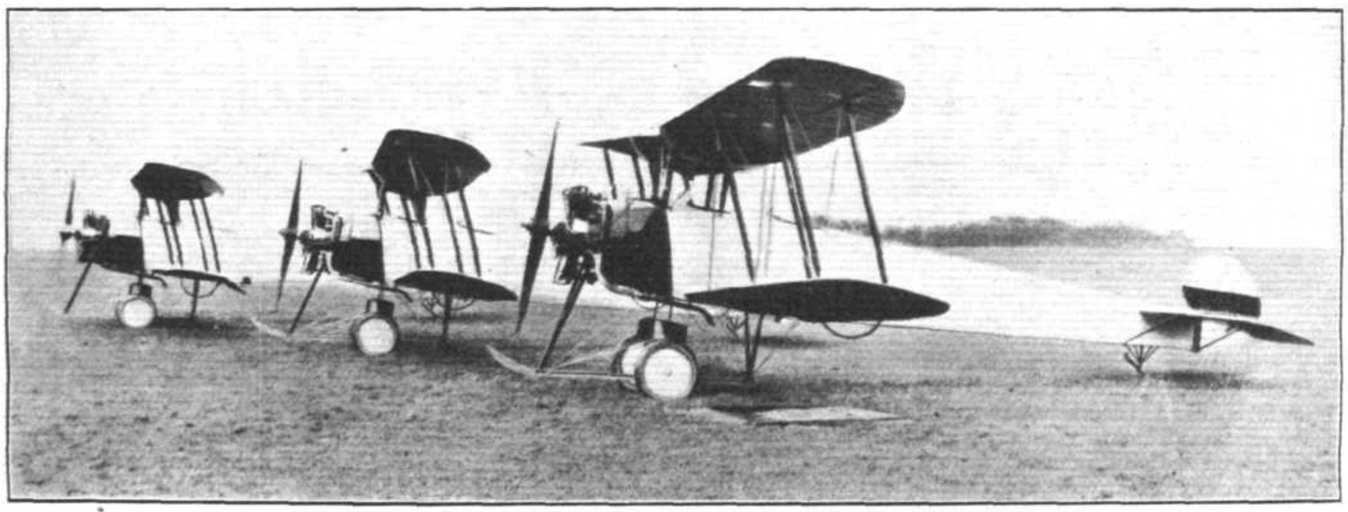
High winds and rain have again interfered with our flying, which is one of our smallest weeks on record.

Friday saw the triumph of nature over man's work. Shortly after 4 p.m. the gale increased in intensity, and as a result of one particularly heavy gust the roof decided to part company with the rest of the hangar. It was lifted clean off and carried over an adjoining road into a field, where it made a real bad landing. With the departure of the roof the hangar doors decided that they could not stand the strain, so they promptly collapsed on to the machines. From out of the wreckage stepped the staff, who were fortunate to be unharmed, although very much surprised.

The machines, which are badly damaged, were removed the next day to alternative accommodation, and today they present a sorry sight, but we are hopeful that the makers will be able to complete the repairs of one machine in the course of a fortnight when we will endeavour to resume our flying.

NORFOLK & NORWICH AERO CLUB

Report for week ending November 17.—Pilot instructor: B. Young. Ground engineer: A. Kirkby. Machines in commission: Two (ZW and QX). Pupils under instruction: Two, 3 hrs. 15 mins. Solo training: Three, 1 hr. 20 mins. "A" pilots: Five, 3 hrs. Total hours flown, 7 hrs. 35 mins.



AVRO "GOSPORTS" FOR ESTHONIA: A. V. Roe & Co., Ltd., of Manchester, have received an order from the Esthonian Government for a number of "Gosport" training machines, fitted with Armstrong-Siddeley "Mongoose" engines. Three of these machines are shown herewith.

Mr. "Bert" Hinkler, who has now returned to England, is here seen with his Avro "Avian" (Cirrus) at the Larkin Aircraft Company's works at Melbourne during his aerial tour round Australia this year following his record flight from England.

REPORT for week ending November 24.—Total hours flown, 1 hr. 50 mins. Pupils under instruction, Two, 1 hr. "A" pilots: Two, 45 mins. Test flights: One, 5 mins.

The last two weeks have been almost uneventful and the gales which have prevailed in Norfolk have practically stopped all flying. Only a day was fit to fly last week; all the rest of the time we looked for the roofs to disappear. Mousehold Aerodrome is quite high, and the wind gets rather boisterous up there. One enthusiastic member arrived from Wisbech, a distance of about 60 odd miles, in the teeth of a gale in the vain hope that he might fly. We like those members; they show the spirit so desirable in airmen, and we were very sorry we had to damp it on this occasion.

SCOTTISH FLYING CLUB, LTD.

REPORT for week ending November 24.—Pilot instructor, Mr. R. M. Stirling. Ground engineer, Mr. W. Calder. Machines in commission during week, X Moth G-EBYG; Avro Avian G-EBTY. Dual instruction, 3 hrs. 40 mins.; solo flying, 20 mins.; joyrides and tests, 1 hr. 40 mins.; total, 5 hrs. 40 mins.

Instruction (with Mr. Stirling): Mr. Fairweather, Mr. Aitken, Mr. Garbutt and Mr. Clark.

Flying during the week has been practically at a standstill on account of almost incessant high wind and torrential rain. On Friday, the aerodrome presented a lake-like picture, being inundated to a depth of nearly 2 ft. at various points. Consequently there is little to report as regards flying matters.

General regret will be felt at the loss the club has sustained with the departure of Capt. A. N. Kingwill, who left Renfrew for the south on Thursday. As a founder of the club and a member of the general committee, Capt. Kingwill has always been a most enthusiastic supporter, and his able advice, particularly in technical matters, has been most invaluable. His place will not be easily filled.

SUFFOLK & EASTERN COUNTIES AEROPLANE CLUB

REPORT for week ending November 24.—Instructor, G. E. Lowdell, A. F.M. Ground Engineers, "C," E. Mayhew; "A," G. Keeley. Three Blackburn "Bluebirds," RE, SZ and UH. Flying time, 9 hrs. 20 mins. Nine members were given dual instruction (4 hrs. 5 mins). One Member flew solo under instruction (25 mins). Flights were made by three "A" Licence members (1 hr. 25 mins). Three passengers were carried (20 mins.). Three trips were made and three passengers carried on the Ipswich-Cambridge Airway (2 hrs. 40 mins.). Four tests were made (25 mins.).

The week has been about as bad for flying as the British climate can manufacture, with the exception of fog. With several members trying to complete tests for "A" Licence before the close of the subsidy financial year, we suspect the Treasury has been tampering with the Controller General of winds and rain at the Air Ministry. If so, we congratulate the latter department on a most successful effort.

Cambridge Aeroplane Club.—In spite of the weather, we were able to have the Cambridge branch open on Monday and Thursday. The weather, however, prevented much activity. Mr. Hart, a new member, had his first trip in a "Bluebird" in a wind of some 40 miles an hour; having already obtained his "A" Licence on a "Moth," the conditions were suitable for advanced dual to become acquainted with the "Blue bird." If we can get a spell of fairly quiet weather after the gales, quite a number of new members will start instruction at the Cambridge Club, which promises to become a very robust offspring of the parent club.

Ipswich-Cambridge Airway.—We appear to have selected the worst possible week to start a scheduled service, as even "Giant Air Liners" have had to remain in their lairs on occasions. We are quite pleased, therefore, to have accomplished three trips to schedule out of four. We might have completed the fourth, but decided that discretion was the better part of valour.

YORKSHIRE AEROPLANE CLUB

REPORT for week ending November 24.—Pilot instructor, G. R. Beck. Ground engineer, R. Morris. Machines in commission, three (RF, TB and SV). Flying time, 4 hrs. 50 mins. Instruction, four (1 hr. 20 mins.). "A" Pilots, six (2 hrs. 55 mins.). Passengers, two (20 mins.). Test flights, three (15 mins.).

Extremely bad weather has prevailed throughout the week, with the exception of one day, on which the above flying time was carried out.

FROM THE FLYING SCHOOLS

Brooklands School of Flying, Ltd., Brooklands Aerodrome

REPORT for week ending November 25.—Instructor, Capt. H. D. Davis. Ground engineers, W. A. Watts, W. H. Hellon. Machines, G-EBVE, G-EBWJ. Flying time, 2 hrs. 50 mins. Pupils under instruction, 5. Soloists, 2. "A" pilots, 2.

Owing to the very severe gales during the week very little flying time has been carried out.

The De Havilland Flying School, Stag Lane Aerodrome

REPORT for week ending November 25.—Total flying time, 23 hrs. 5 mins. Instruction: Dual, 7 hrs. 30 mins.; solo, 8 hrs. 35 mins. Other flying, 7 hrs.

The low flying time is accounted for solely by the very high winds, which have swept the aerodrome for practically the whole of the week.

OVERSEAS CLUBS

SINGAPORE FLYING CLUB

REPORT for week ending October 20.—Total flying time, 21 hrs. 4 mins. Solo, 1 hr. 5 mins. Dual, 16 hrs. 13 mins. Photography, 1 hr. 5 mins. Joy-rides, 2 hrs. 16 mins. Tests, 25 mins.

Flying in the early mornings has been impossible on several days this week, due to rain, but, apart from this, the weather has been good.

We now have several members who are practically ready to go solo, but it has been decided not to launch any new pilots whilst there is only one machine in action.

Mr. L. W. Learmount came down from Kuala Lumpur for the week-end on October 20.

Up-country members are welcomed, and providing notice is received of their arrival, they are given precedence over local members in respect of flying time.

Play

SENORITA DE ALVAREZ, the well-known lawn tennis player, intends to become a private owner of a light aeroplane. She is now training to qualify as a pilot at Stag Lane Aerodrome.

Private Owner's Fortune

THE Hon. David Tennant, the private owner-pilot of a D.H. "Moth X," and a B.B.C. announcer, has been left a fortune of £90,000 through the death of his mother, the late Viscountess Grey.

Sheffield Flying Club

THE organisers of the proposed Sheffield Flying Club have decided that in view of the possible acquisition of Coal Ashton Aerodrome by the Corporation, the club should be formed at once.

An Aeroplane Club for New Zealand

A MOST successful inaugural meeting of an Aeroplane Club in Whangarei, New Zealand, took place on April 24, 1928. The convenor stressed the need for all services to be voluntary, and explained that the Government proposed to grant a subsidy of £25 for each member who became a qualified private pilot. Offers of those who would undertake to become private pilots were called for, and the requisite number was obtained, to the gratification of all present. The list included two ladies. A temporary committee was appointed for the purpose of endeavouring to obtain an aeroplane and to draft rules. In conclusion, the chairman thanked all present for their splendid co-operation, and also the convenors, Mr. A. D. Laurenson and Colonel Lockie, for their untiring efforts in the formation of the Club.

Hanworth Aerodrome

THE proposed aerodrome at Hanworth Park, Feltham, to be established under Capt. F. E. Guest's aviation scheme, is the site used during the war for aviation purposes. The Whitehead Aircraft Co were located there.

THE ALL-METAL LIGHT 'PLANE

Canadian Reid "Rambler"

THE flying club movement in Canada has spread rapidly during the last year and thereby made some of the most lucrative orders for manufacturers of light aeroplanes. Needless to say, England has had the greatest benefit of this progress and has certainly laid a firm foundation for continued success. Inevitably, though, designers are being attracted to such a promising market, and we see local production in the light 'plane class heralded by the appearance of the Canadian Reid "Rambler," of which brief reference was made in our columns recently.

Even in this local effort, however, an Englishman is the responsible person. The designer, Mr. W. T. Reid, was formerly of the Royal Aircraft Establishment and the Bristol Aeroplane Co., Ltd. He went to Canada some time ago as designer for Canadian Vickers, Ltd. Now he has formed the Reid Aircraft Company of Montreal, to produce his own design. The primary rate of production will be two a week, and when their plant is extended the rate will increase to seven a week.

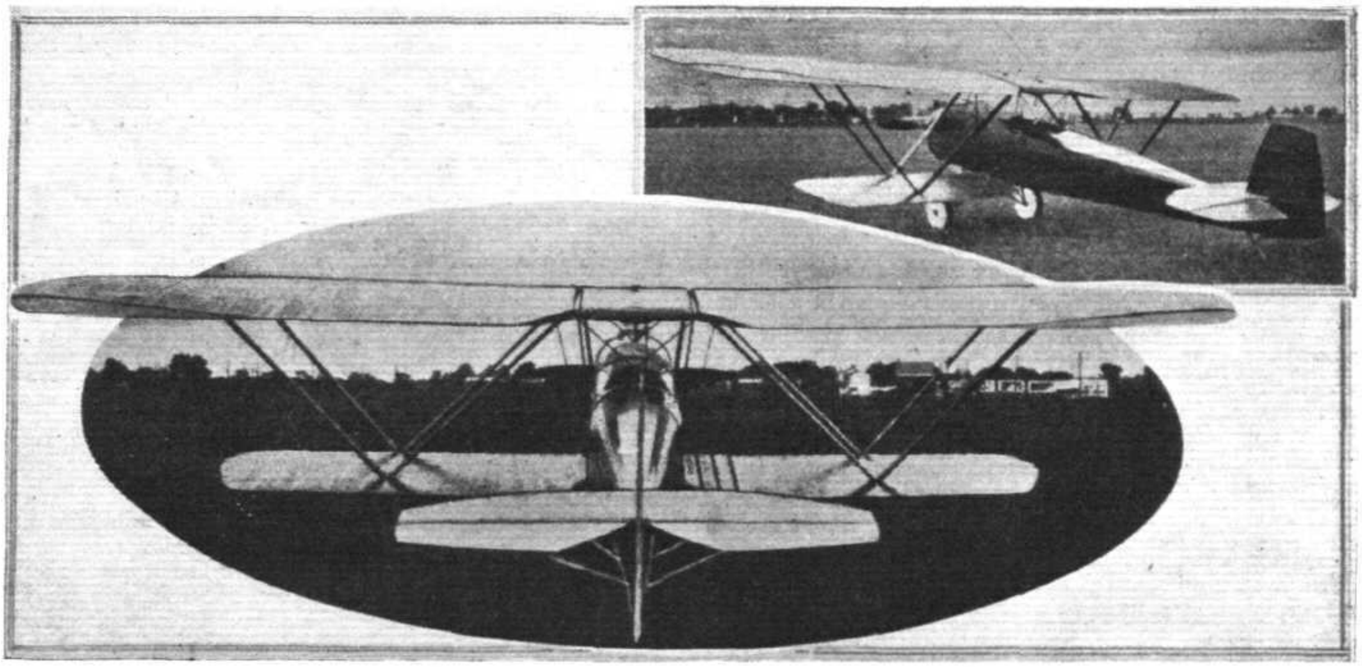
involves a form of rubber buffer, consisting of a series of rubber discs of approximately streamline shape which become compressed under the shock of landing. Differential hydraulic brakes are standard. Tail skid is of simple design and the shoe is easily removable in the event of wear. A metal propeller is standard.

Skiis or twin floats are interchangeable with the land chassis. There is a dual control system, and an adjustable spring is fitted to the elevator controls to trim the machine in flight.

In the gravity feed system is fitted a tank cock so that in flight a quantity of petrol sufficient for half an hour's flight is trapped as an emergency supply.

Complete set of instruments is fitted on an indirectly lighted panel of automobile pattern, and there is a luggage compartment behind the rear cockpit. Engine installed is an A.D.C. "Cirrus" Mk. II.

Dimensions :—Length of machine when the wings are open is 22 ft. 6 in. and when wings are folded, 24 ft. 6 in.



Two views of the all-metal Reid "Rambler" light aeroplane fitted with an A.D.C. "Cirrus" Mk. II engine. It is a new Canadian production and will soon be produced, according to present plans, at the rate of seven per week.

One of the machine's foremost features is the all-metal construction. The experience of the manufacturers has apparently proved to them that a wooden machine would not be equal to the climatic conditions. The changes in temperature result in the expansion and contraction of wood. This Reid "Rambler" is a sesquiplane type, the top wing being of considerably greater area than the lower wing, and the usual folding qualities are applied. A very wide view from the two in-line cockpits appears obtainable owing to the small area of the lower wing.

Wing spars and ribs are made of a strong aluminium alloy. The ribs, which are one-piece pressings, are riveted to the spars. All internal bracing is tubular, whilst the vee-shaped interplane bracings are of streamline seamless steel tubing—which obviates rigging adjustments.

In the top centre plane is the gravity tank, with a capacity of 20 gallons. Seamless steel tubing is also employed in the design of the tail plane, elevators and rudder. The supporting struts for the tail plane from the fuselage are streamline steel.

A special type undercarriage, with a wheel track of 6 ft.,

Span of wings, 33 ft. Width of machine with folded wings 11 ft. 1 in. Height, 8 ft.

Weights :—Machine empty weighs 850 lbs.; petrol (20 galls.) 145 lbs.; pilot and passenger, 180 lbs. each; luggage, 80 lbs. Useful load, 600 lbs. Total loaded weight is 1,450 lbs.

Performance :—Top speed, 102 m.p.h.; landing speed, 38 m.p.h.

Apart from utility for private owners, flying clubs and schools, the Reid "Rambler" has claims for forestry patrol work and transportation work where economical conveyance of single passengers or equivalent weight of freight is required. A certificate of airworthiness, issued by the Director of Civil Aviation, Ottawa, is supplied with every machine.

The Reid Aircraft Company is controlled by Capt. W. S. Lighthall (Chairman), Mr. W. T. Reid (President), Major T. C. Lamb, M.C. (Director) Capt. E. F. Peacock (Vice-President) and Capt. C. Barclay Drummond (Director). Mrs. W. T. Reid made the first passenger flight in the "Rambler" last September.

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"D.H. Gazette"

A NOVEMBER issue of the *D.H. Gazette* has appeared in a new form. The chief change is in size, which has expanded. There is, however, no sacrifice whatever of the usual excellency of production, the clear bold type, the art paper, and, most of all, the informative, chatty contents. All the major events in the recent history of the de Havilland Company are a feature of the issue, profusely illustrated with live, intimate photographs. The interests of the company are spread so widely throughout the world that its Gazette is much more than a mere works magazine restricted to local items. The Editors can be congratulated on the improvement. Copies can be obtained from the company, 7½*d.* each, post free.

THE ROYAL AIR FORCE

London Gazette, November 20, 1928.

General Duties Branch

The follg. are granted short service commn. as Pilot Officers on probation with effect from Nov. 9, and with seniority of Nov. 2 :—A. C. R. Mackenzie, E. C. Ridley. Pilot Officer A. E. J. Pratt is promoted to rank of Flying Officer (Nov. 2) ; Flight-Lieut. O. G. Gregson is placed on retired list at his own request (Nov. 18) ; Flying Officer F. H. S. David relinquishes his short service commn. on account of ill-health (Nov. 21). The short service commissions of the following Pilot Officers on probation are terminated on cessation of duty :—J. F. Macdonald (2nd Lieut., H.L.I., T.A.) (Nov. 9) ; L. P. Thomas (Nov. 17). *Gazettes*, Nov. 6, concerning the following are cancelled : J. A. Lawson (Lieut., A.I.R.O.), W. H. E. Tew, E. C. A. Wheeler.

Stores Branch

The follg. Pilot Officers on probation are confirmed in rank and promoted to rank of Flying Officer (Oct. 15) :—C. J. Cousins, C. Thripp, H. A. Wrigley.

Medical Branch

Flight-Lieut. A. Briscoe, M.B., is promoted to rank of Sqdn. Leader (Nov. 19).

Chaplains' Branch

The Rev. C. A. B. Allen, M.A., is granted the local relative rank of Wing Commander whilst employed as Senior Chaplain (Iraq) (Oct. 26) ; the Rev. G. H. Collier, M.A., relinquishes the local relative rank of Wing Commander on ceasing to be employed as Senior Chaplain (Iraq) (Oct. 26).

RESERVE OF AIR FORCE OFFICERS

General Duties Branch

Pilot Officer R. H. Maw is promoted to rank of Flying Officer in the Special Reserve (Nov. 2). The following officers are transferred from Class A to Class C :—Flight-Lieut. G. E. Newton (Oct. 18) ; Flying Officer W. C. Venmore (Aug. 26). Flying Officer M. R. Banks is transferred from Class C to Class A (Oct. 29) ; the commission of Pilot Officer on probation D. L. Hodge is terminated on cessation of duty (Oct. 20) ; *Gazette*, Oct. 9, concerning Flying Officer E. Fulford is cancelled.

AUXILIARY AIR FORCE

General Duties Branch

No. 600 (City of London) (Bombing) Squadron :—The following to be Pilot Officer :—D. L. Doyle (Oct. 11).

No. 601 (County of London) (Bombing) Squadron :—The following Flying Officer to be Flight-Lieut. :—F. D. W. Reid, M.B. (Oct 1).

ROYAL AIR FORCE INTELLIGENCE

Appointments.—The following appointments in the Royal Air Force are notified :—

General Duties Branch

Group Captains : K. G. Brooke, C.M.G., to R.A.F. Depot, Uxbridge, 28.10.28. A. W. Bigsworth, C.M.G., D.S.O., A.F.C., to H.Q., Coastal Area, for duty as Chief Staff Officer, 3.11.28.

Wing Commander J. McCrae, M.B.E., to Armoured Car Wing, Iraq, to command, 21.10.28.

Squadron Leaders : C. J. Mackay, M.C., D.F.C., to R.A.F. Depot, Uxbridge, 28.10.28. J. J. Breen, to No. 84 Sqdn., Iraq, 22.10.28. F. J. Vincent, D.F.C., to No. 45 Sqdn., Middle East, 30.10.28. J. H. Green, to H.Q., R.A.F., Transjordan and Palestine, 27.10.28. A. Durston, A.F.C., to H.Q., Cranwell, 13.11.28. P. A. Shepherd, to H.Q., Inland Area, Stanmore, 7.11.28.

Flight-Lieutenants : N. V. Wrigley, to Central Flying Sch., Wittering, 28.11.28. W. J. Seward, to H.Q., Iraq Command, 15.11.28. E. H. Searle, to No. 23 Sqdn., Kenley, 12.11.28. R. de L. Stedman, to Central Flying Sch., Wittering, 20.11.28. J. G. Murray, to No. 406 Flight, Donibristle, 15.11.28. N. W. Wadham, to No. 216 Sqdn., Egypt, 4.11.28. A. Rowan, to R.A.F. Depot, Egypt, 4.11.28. C. B. Greet, to No. 14 Sqdn., Palestine, 7.11.28. E. M. Drummond, to No. 84 Sqdn., Iraq, instead of to H.Q., Iraq Command, as previously notified, 20.10.28.

Flying Officers : A. R. Ward, to No. 442 Flight, China, 13.11.28. T. B. Prickman, to No. 45 Sqdn., Middle East, 27.10.28. M. A. Platts, to No. 2 Armoured Car Coy., Middle East, 30.10.28. C. Warsow, to No. 14 Sqdn., Middle East, 3.11.28. H. L. Drake, to No. 5 Sqdn., India, 16.10.28. C. A. C. Patton, to No. 45 Sqdn., Egypt, 3.11.28. N. Young, to R.A.F. Station, Donibristle, 10.11.28. A. L. Ottway, to R.A.F. Depot, Uxbridge, 11.11.28. H. H. V. Tristem, to R.A.F. Depot, Uxbridge, 13.11.28. V. S. Bazalgette, to No. 13 Sqdn., Andover, 12.11.28.

Pilot Officers : G. E. E. Singleton, to No. 14 Sqdn., Middle East, 27.10.28. D. Menzies, to No. 45 Sqdn., Middle East, 28.10.28. R. David, to R. A. F. Base, Kai-Tak, China, 13.11.28. The undermentioned are posted to No. 4 Flying Training Sch., Middle East, with effect from 15.11.28 :—A. H. Abbott, F. S. Barron, A. G. M. Cary, C. B. Field, E. G. Granville, N. R. G. Hunter, R. I. Johnson, H. L. McCulloch, R. M. Messiter, G. F. P. O'Farrell, O. J. O'Hara, C. E. W. N. C. Pelly, C. Sarsfield-Samson, R. W. Wallace, T. E. Whittome, A. C. R. Mackenzie, and E. C. Ridler.

Stores Branch

Flight Lieutenants : L. H. Hillier, to R.A.F. Depot, Uxbridge, 31.10.28. W. Sutherland, M.B.E., to Armoured Car Wing, Iraq, instead of to H.Q., Iraq Command, as previously notified, 20.10.28.

Flying Officers : E. G. M. Charleson to No. 4 Flying Training Sch., Middle East, 30.10.28. M. H. Jenks, to H.Q., Wessex Bombing Area, Andover, 6.11.28. M. M. McMullan, to Station H.Q. and Storage Section, Andover, 5.11.28.

Accountant Branch

Flying Officers : R. T. Carter, to No. 6 Sqdn., Iraq, 6.11.28. J. P. Cave, to H.Q., Middle East, 2.11.28. J. H. S. Richards, to No. 84, Sqdn., Iraq., instead of to Station H.Q., Hinaidi, as previously notified, 20.10.28.

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BRITISH AIR FORCES

AN interesting publication called " Notes on the Land and Air Forces," for 1928, has been published by His Majesty's Stationery Office (1*s*. 3*d*. net.). It gives in summary land and air defence forces in the British Overseas Dominions, Colonies and Protectorates, etc. We quote some sections.

South Africa

The South African Air Force consists of a small permanent force entirely concentrated at Robert's Heights, Pretoria, where accommodation in the shape of steel hangars exists for 80 aeroplanes. Landing grounds have been prepared throughout the Union which can be reached by air from Pretoria within one day. At full establishment there is one Service squadron of three flights. All commissioned personnel of and under the rank of Captain are on short service, and can be retained up to a maximum age of 35 years, when they pass to the Special or General Reserve. A Special Reserve of Pilot Officers consisting of those who served formerly in the R.A.F. and have undergone refresher courses with the S.A.A.F., also form part of the force. They are required to do three weeks' training annually, and are retained up to a maximum age of 40 years, after which they transfer to the General Reserve. This General Reserve of Officers is also composed of officers of former R.A.F. service, but who have not undergone refresher courses with the S.A.A.F. At the age of 50 years they are retired.

New Zealand

In New Zealand there is a permanent Air Force and a Territorial Air Force. The former is raised by voluntary engagement, and is a unit of the permanent military forces. The authorised establishment is 5 officers and 14 other ranks, and at present the unit is up to strength. It consists of an Air Force depôt and training school, and the base is the Wigram aerodrome, Christchurch. A combined air base will be at Hobsonville, where the property has been purchased, but its establishment has not yet matured. The Territorial unit had a strength of 101 officers some time ago.

Canada

In Canada there is proposed a Permanent Air Force of 153 officers and 660 airmen, and a non-permanent active Air Force of 67 officers and 130 airmen. There is also a Reserve Force. In the Permanent Force applicants must be British subjects between the ages of 18 and 45, and must engage to serve for three years. The headquarters are at Camp Borden, Ontario and Vancouver, B.C. A limited number of R.C.A.F. officers attend courses of instruction in England, and three are on exchange with Royal Air Force officers. The R.A.F. system of training and of promotion is followed more or less faithfully.

Australia

There is a Permanent Air Force with a Reserve, and a Citizen Air Force in Australia, which correspond to our R.A.F. and its Reserve and our Special Reserve. The personnel of the Permanent Air Force is engaged voluntarily for a period of six years, with the option of re-engagement for further periods of six years until the retiring age is reached. For the year 1927-28 the Permanent Air Force had an establishment of 110 officers and 850 airmen, and on December 31, of 1926, the Citizen Air Force had 54 officers and 285 airmen. Headquarters of the R.A.A.F. are at Melbourne. The air establishments are at Point Cook, (Victoria), Laverton, (Victoria), and Richmond and Sydney in New South Wales. Training of the Permanent Force is again modelled on the R.A.F. system. Pilots of the Citizen Force receive four months' training during their first year of service, and after, if qualified pilots, they do 25 days' training per year. Incidentally, that period is considerably augmented by voluntary work.

Civil aviation in Australia is administered by a Controller, who is responsible to the Minister for Defence. There are many air services operated by private companies, which receive Government subsidies.

Light aeroplane clubs have been formed under two schemes —first, by which the Government supplies the aircraft and pays £20 for each graduate, and, secondly, the Club finds all aircraft and the Government pays £40 for each graduate, with a maximum of 50 graduates in any one year. Eight clubs have actually been formed.

NOTICE TO GROUND ENGINEERS.

Avro 504.N : Essential Modifications

1. The modifications described herein must be satisfactorily incorporated in all existing Avro 504 N civil aircraft before any such aircraft is submitted for re-inspection for renewal of the Certificate of Airworthiness.

2. *Guard for Pilot's Heel.—Modification No. Avro 504N/29.*

(*a*) In order to prevent the pilot's heels from becoming accidentally jammed between the footboard and the steel tubular diagonal frame member (Item No. 12/D.675), guards constructed of sheet aluminium are to be fitted to all Avro 504 N civil aircraft.

(*b*) Each guard is to be fastened to the front wooden cross member supporting the seat bearers by means of two wood screws, to the footboard by means of a series of wood screws, and to the diagonal tubular member by two clips.

(*c*) The arrangement is shown in Drawing No. V. 1375.

(*d*) The undermentioned items will be required in connection with the incorporation of this modification :—

Part No.	Description.	No. off.
3. V. 1375	Bracket guard, L.H., for pilot's foot ..	.. 1
4. V. 1375	Bracket guard, R.H., for pilot's foot ..	.. 1
5. V. 1375	Clip for pilot's foot guard bracket ..	.. 4

3. *Tail Skid Cables.—Modification No. Avro 504 N/43.*

(*a*) The 10-cwt. cables are to be replaced forthwith by 20-cwt. cables on those Avro 504 N aircraft fitted with compression rubber tail skid shock absorbers.

(*b*) This change will necessitate enlarging the hole in the shackle from $\frac{1}{4}$ in. to $\frac{5}{16}$ in. and fitting a correspondingly larger ferrule. Part No. 5SS 351.

(*c*) It will be necessary to substitute the existing eyebolts anchoring the two upper cables by larger eyebolts, Part No. SS 1425 F.

4. *Wing Skid Sockets.*

(*a*) It has been found that on certain Avro 504 N aircraft the small bolt which secures the wing skid in its front socket is incorrectly fitted in such a way that it lies parallel to the spar instead of to the chord. In this position the bolt is liable to foul the aileron pulley when the skid comes into contact with the ground.

(*b*) All Avro 504 N aircraft should, therefore, be examined in this respect and, if the above-mentioned bolt is found to be wrongly fitted, a fresh hole should be drilled in the skid and socket to take the bolt in its correct position, *i.e.*, lying parallel to the wing chord.

5. No Certificate of Airworthiness will be issued or renewed in respect of any Avro 504 N. civil aircraft unless the above-mentioned modifications have been satisfactorily incorporated.

6. Drawings of these modifications can be obtained on application and prepayment from the Drawings Library, Air Ministry, Kingsway, London, W.C.2.

(No. 6 of 1928.)

IN PARLIAMENT

Farnborough Factory Industrial Staff

Sir S. Hoare, on November 21, in reply to Mr. Kelly, said the numbers of industrial staff employed at the Royal Aircraft Establishment were 832 men and 23 women on July 1 and 841 men and 26 women on October 1, 1928.

Aviation and Damage to Property

Sir A. Holbrook on November 26, asked the Secretary of State for Air whether he will consider the adoption of a regulation compelling the owner of every private aeroplane to join a licensed organisation, which shall be held responsible for all damage to property wrought by its members or associates through accident or otherwise?

Sir S. Hoare: In general, so far as I am aware, the owners of private aircraft do already cover third-party risks by insurance, and I am not satisfied that the need has been shown for the adoption of such a suggestion as that put forward.

The Bristol "Jupiter" Family

It is regretted that owing to exceptional pressure on our space it has been necessary to hold over this week the instalment dealing with the Bristol "Jupiter" engines. It will be published next week.

A Modern Story

A fascinating little volume of an original trend in advertising literature has been written and produced by G. Street and Co., Ltd., for the de Havilland Aircraft Co., Ltd. In vivid black and white artistry a series of small illustrations trace the common transport experiences of typical "Bright Young Persons" and the inevitable evolution from the perambulator to the D.H. "Moth" for deliverance from the congestion common to terrestrial motion to the freedom of the skies. It is a live pictorial study of a modern story with the moral in the title which is "the higher the fewer."

A Work of Art

A new edition of the album issued by D. Napier and Son, Ltd., is a beautifully illustrated work of art. There are excellent smooth, sepia photographs of the numerous types of military and naval aircraft in which Napier aero engines are installed and others of the engines themselves. The set reveals how extensively the Napier types are used from single-seater fighters and racing aircraft to twin-engine bombers; also in commercial aircraft and seaplanes and flying boats. Each machine in the album is summarily described in three languages—namely, English, French, and Spanish; and there is a general introduction of greater length, also in those three languages. Another feature is a complete specification of the latest type Napier engine, Series XI. The Napier-Campbell racing car is another interesting illustration. There is a formidable list of Napier engine achievements showing the prominent part the types have played continually in the modern history of aviation in all spheres, from long-distance flying to racing. Sundry Aerial Derby races and Schneider Trophy races were some of the triumphs, whilst to-day the Napier racing engine holds the British speed record. This album is a handsome possession, pictorially and informatively.

Wico Magnetos

The National Supply Corporation, River Plate House, Finsbury Circus and South Place, London, E.C.2, have introduced a new-type B-I Wico magneto, a hand-starting magneto for aero engines which, it is understood, works on an entirely different principle to the conventional rotary armature magneto. The Corporation states that the Air Ministry is making a type test.

PUBLICATIONS RECEIVED

U.S. National Advisory Committee for Aeronautics Technical Notes. No. 289.—Preliminary Biplane Tests in the Variable Density Wind Tunnel. By J. Shoemaker. June, 1928. *No.* 290—Welding of High Chromium Steels. By W. B. Miller. June, 1928. *No.* 291.—Gluing Practice at Aircraft Manufacturing Plants and Repair Stations. By T. R. Truax. July, 1928. *No.* 292—The Drag of a J-5 Radial Air-cooled Engine. By F. E. Weick. July, 1928. *No.* 293—The Formation of Ice Upon Exposed Parts of an Airplane in Flight. By T. Carroll and W. H. McAvoy. July, 1928. U.S. National Advisory Committee for Aeronautics, Navy Building, Washington, D.C., U.S.A.

Aeronautical Research Committee Reports and Memoranda: No. 1150.—List of Reports and Memoranda of the Aeronautical Research Committee. Published between March 1, 1927, and June 30, 1928. July, 1928. Price 4*d.* net. *No.* 1162 (*Ae.* 326).—A Summary of the Experimental and Theoretical Investigations of the Characteristics of an Autogyro. By H. Glauert and C. N. H. Lock. April, 1928. Price 4*d.* net. H.M. Stationery Office, Kingsway, London, W.C 2.

The A.B.C. of Flying. By Lieut.-Col. W. Lockwood Marsh. John Hamilton, Ltd., 90, Newman Street, London, W.1. Price 2*s.* 6*d.* net.

Catalogue

Scientific and Technical Books. Sir Isaac Pitman and Sons, Ltd., Parker Street, Kingsway, London, W.C.2.

AERONAUTICAL PATENT SPECIFICATIONS

(*Abbreviations*: Cyl. = cylinder; i.c. = internal combustion; m. = motor. The numbers in brackets are those under which the Specifications will be printed and abridged, etc.)

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Published November 29, 1928

20,885. J. Stone and Co., Ltd., F. J. Pike and H. Neville. Screw propellers. (299,923.)

22,329. Blackburn Aeroplane and Motor Co., Ltd., and G. E. Petty. Mounting of guns on aircraft. (299,940.)

APPLIED FOR IN 1928

Published November 29, 1928

13,201. H. and M. Farman. Arrangement of cylinders and parts in i.c. engines for aeroplanes. (290,975.)

13,561. A. C. Bowden. Coupling or connecting devices for parachutes. (300,094.)

18,546. G. Guttner. Rotary engines. (300,107.)

27,643. Rohrbach Metall-Flugzeugbau Ges. Monoplanes. (297,752.)

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